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FEASIBILITY OF USING LAKE STATES HARDWOODS FOR NEWSPRINT AND OTHER PULP AND PAPER PRODUCTS



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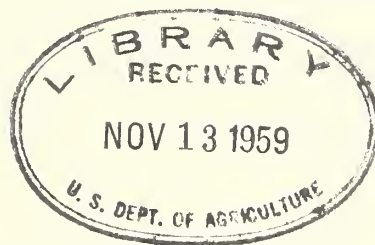
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**FEASIBILITY OF USING LAKE STATES HARDWOODS
FOR NEWSPRINT AND OTHER PULP AND PAPER PRODUCTS**



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U. S. Forest Service
U. S. Department of Agriculture
50 Washington, D. C.

April 1959//
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PREFACE

The purpose of this report is to indicate the technical and economic feasibility of expanding use of aspen and mixed northern hardwoods in the Lake States for production of newsprint and other pulp and paper products. It has been prepared in response to growing interest in the possibilities of basing an expanded pulp and paper industry on relatively abundant supplies of these northern hardwoods.

In recent years capacity of both the newsprint industry and all other branches of the pulp and paper industry in the United States has been substantially increased. Thus between 1944 and 1958 newsprint production in the United States increased from 721 thousand tons to 1,723 thousand tons; in 1958 U. S. production of newsprint amounted to 27 percent of domestic consumption in contrast to a low of less than 17 percent in 1949. Production of other grades of paper and board in the United States also has increased rapidly from 16,462 thousand tons in 1944 to 29,074 thousand tons in 1958.

Hardwoods have been used in steadily increasing quantities by the expanding paper and board industries, but almost entirely for various grades of paper and board other than newsprint. Use of hardwoods in the Lake States, for example, has risen rapidly to a point where aspen and other hardwood species now account for 44 percent of the pulpwood consumed in that region.

With the growing pressure on supplies of softwood pulpwood and development of new pulping technology, the possibilities of further expansion in use of domestic hardwoods have assumed increasing importance. At least three U. S. newsprint mills, for example, are currently utilizing hardwoods in some degree for newsprint, and there is widespread interest in the possibilities of further major expansion in use of hardwood pulps to meet prospective demands for newsprint.

The expanding use of hardwoods for a variety of paper and board products also clearly indicates that newsprint represents only one of a number of highly promising uses for hardwood pulps. This report, therefore, appraises three possibilities, including: (1) a commercial newsprint mill, (2) a sulfate pulp mill to produce bleached hardwood pulp for sale to converting plants, and (3) a cold-soda pulp mill to be constructed in conjunction with an existing pulp and paper mill in the Lake States region.

Information is presented in this report on a number of items relevant to judging the feasibility of such increased pulp and paper production in the Lake States, including: (a) consumption trends and prospective markets for newsprint, other paper products, and woodpulp in the United States, (b) the technical feasibility of using hardwoods such as aspen, beech, birch, and maple in the manufacture of newsprint and hardwood market pulps, (c) the availability of timber resources in the Lake States region to support expanded plant capacity, and (d) the estimated costs of producing and marketing newsprint and hardwood pulps in the Lake States area.

This analysis of the feasibility of using hardwoods in the production of newsprint and other woodpulp products in the Lake States is necessarily a generalized and preliminary analysis. The evidence presented and conclusions reached with respect to newsprint production, for example, have been based to a large degree on laboratory tests and on observations or reports on related industrial experience. It must be emphasized that additional mill trials on a commercial scale are essential for more exact appraisals of the opportunities for use of hardwoods in newsprint. Detailed studies of specific plant locations also will be necessary to determine precisely the economic feasibility of producing newsprint or hardwood pulp by any particular company at any particular location.

CONTENTS

	<u>Page</u>
Summary and Conclusions.....	1
Chapter I - The Market Outlook for Newsprint and Other Pulp and Paper Products.....	4
A. Newsprint.....	4
Consumption of newsprint has nearly doubled since 1940.....	4
Further large increases in newsprint demands expected	4
Newsprint consumption concentrated in the central and north-eastern States	4
Canada supplies most of the newsprint used in the United States	5
U. S. newsprint production increasing.....	10
Current capacity in excess of demand.....	10
Newsprint prices at all-time high	12
Freight charges on newsprint an important competitive factor .	13
B. Markets for other paper and board.....	15
Consumption of paper and board products other than newsprint also increasing rapidly.....	15
Favorable market location for Lake States mills	15
Further expansion of demands for paper and board anticipated .	15
Capacity currently in excess of production	18
Large expansion in woodpulp consumption required.....	19
Part of woodpulp sold as market pulp	22
Potential markets for pulp produced in the Lake States.....	22
Chapter II - Technical Suitability of Hardwood Pulps for Newsprint and Other Products	25
A. Newsprint.....	25
High-speed machines required for newsprint production	25
Softwood pulp mixtures mainly used for newsprint	25
Hardwood semichemical type pulps suitable for use in newsprint.....	26
Variable yields obtained from semichemical type pulps	27
Bleaching requirements depend on species used	27
Aspen groundwood pulp also suitable for use in newsprint	28
Laboratory and commercial experience indicate varied possibilities for using hardwoods in newsprint.....	28
Newsprint furnish containing mainly pulps from northern hardwoods considered feasible	28
Additional commercial testing needed.....	30
B. Other pulp and paper products.....	31
Many types of paper and board produced in the Lake States	31
Opportunities for increased production of hardwood sulfate and cold-soda pulps	32

CONTENTS--Continued

	<u>Page</u>
Pollution control required for new plants in Lake States	33
Pollution varies widely by pulping process	33
Mill sites available in the Lake States region.....	35
Chapter III - Pulpwood Supplies and Costs in the Lake States	37
Lake States forests are primarily hardwoods	37
Hardwood pulpwood makes up increasing portion of pulp mill receipts.....	38
Pulpwood use concentrated in Wisconsin but wood obtained mainly from out of State	40
Surplus allowable cut of hardwoods available in most parts of region	41
Net surpluses of softwoods are small	43
Timber growth and volumes increasing	45
Pulpwood timber available for increased capacity	45
Timber ownership influences availability of pulpwood	45
Canadian wood important to Lake States mills	46
Competition from other wood-using industries is limited.....	46
Wood costs in the Lake States vary widely by species	47
Wood transportation costs vary widely	49
Estimated wood costs f.o.b. mill	49
Hardwood shows low costs per ton of wood fiber	50
Timber supply conditions in other regions an important competitive factor.....	52
Chapter IV - Economic Analysis of Selected Paper Industry Projects in Wisconsin.....	54
I. Introduction.....	54
II. Conclusions.....	56
III. Pulpwood Supply.....	58
IV. Capital costs	60
V. Operating costs and income.....	64
Appendix Tables.....	78

SUMMARY AND CONCLUSIONS

The principal findings and conclusions of this report may be summarized as follows:

1. Consumption of newsprint and of other grades of paper and board has been expanding very rapidly in the United States, and further major expansion of markets for these products is anticipated. Newsprint consumption in 1957 totaled 6.8 million tons. Projections indicate market demands may reach about 8.5 million tons by 1965 and 10 million tons by 1975. Projections of consumption trends for other grades of paper and board indicate that consumption of 28.5 million tons of these products in 1957 may increase to about 50 million tons by 1975, or a rise of 75 percent. Excess capacity in the pulp and paper industry is a problem for the time being, but continued economic growth in the United States is expected to result in resumption of the long-run expansion of demand for essentially all products of the pulp, paper, and board industries.

2. The United States is essentially self-sufficient in production of practically all grades of paper and board, with the notable exception of newsprint. For various technical and economic reasons Canada has long supplied most of the newsprint used in the United States. In recent years, however, United States newsprint capacity has been increasing rapidly, particularly in the southern States. In 1958 domestic production amounted to 1.7 million tons, or 27 percent of U. S. consumption.

3. The largest markets for newsprint as well as other grades of paper and board, both now and prospectively, are in the Central and Northeastern States. Consumers in the Central, Lake, and Plains regions, relatively near to the pulp and paper producing

areas of the Lake States, use more than 2 million tons of newsprint annually or about one-third of the U. S. total. Newsprint can be shipped from Lake States mills to major consuming centers in these regions for \$5.00 to \$8.00 a ton less than shipments from competing regions.

4. Lake States mills also are favorably located to supply other major consumers of pulp, paper, and board products. Production of hardwood sulfite pulp for use in integrated mills or for sale as market pulp, and production of cold-soda hardwood pulp for use at established mills in the Lake States appear especially promising both from a market standpoint and availability of suitable timber supplies. These pulp products are therefore included along with newsprint in this appraisal of opportunities for expanded use of hardwoods in the Lake States.

5. Laboratory and commercial experience have established the technical feasibility of producing newsprint from furnishes containing substantial amounts of aspen groundwood and semichemical type hardwood pulps. This is partly the result of improved technology for producing hardwood pulps by the cold-soda, the chemigroundwood, or the neutral sulfite semichemical process. Hardwoods such as aspen, maple, birch, and sweetgum are today being used in a number of newsprint mills.

6. On the basis of laboratory experience and observations of various furnishes used at commercial newsprint mills, it is concluded that a newsprint furnish consisting of 60 percent aspen groundwood, 15 percent cold-soda pulp from mixed hardwoods, and 25 percent unbleached softwood sulfite or semibleached softwood sulfate pulp could be run effi-

ciently on modern high-speed paper machines. Properties of papers made experimentally with this furnish are reasonably close to the average properties of the commercial newsprint paper produced today. Various other combinations of hardwood and softwood pulps might also be used successfully in production of newsprint.

7. Experience to date in the use of hardwoods in newsprint is highly promising, but current judgments as to the technical and economic feasibility of using larger amounts of hardwoods as indicated above need to be verified by large-scale commercial trials under practical operating conditions. Such trials together with further research in pulp and paper making processes are needed to establish conclusively the optimum combination of pulps in any particular mill, and the need for modifications of equipment or methods to permit high-speed operation of newsprint machines.

8. The technology and commercial practices in using bleached hardwood sulfate and other hardwood pulps for printing, bond, and various other grades of paper and board are well established.

9. Hardwood timber resources in the Lake States region are available in sufficient quantity to support a substantial expansion of the pulp and paper industry for newsprint, hardwood sulfate and cold-soda pulp, or other products. An excess of allowable cut of both aspen and mixed hardwoods is present in all States, although the available allowable cut of aspen is largely concentrated in Minnesota and Michigan.

10. Supplies of softwood pulpwood in the Lake States are relatively short and the industry for many years has imported substantial quantities of softwoods from Canada and other States. Some current excess of allowable cut of softwoods does

exist, but this is mainly concentrated in northern Minnesota.

11. It is concluded that the aspen pulpwood and the softwood pulpwood required for new plant capacity to produce newsprint could be obtained in the region. However, if this capacity were located in Wisconsin rail transportation costs and wood costs f.o.b. mill for these species would be relatively high.

12. Economic analyses of selected paper industry projects to be located in northern Wisconsin have been made by Ebasco Services, Incorporated, a major engineering and consulting firm located in New York City. These pointed to the following conclusions:

(a) Income statements for a newsprint mill having a capacity of 500 tons per day of standard newsprint indicate for the first five years of plant operation at full nominal capacity a profit margin of 6.9 percent of net worth. This compares unfavorably with the 1957 average of 10.5 percent for 10 large newsprint manufacturers.

(b) Income statements for a sulfate (kraft) pulp mill having a capacity of 300 tons per day of bleached hardwood pulp indicates a profit margin amounting to 11.6 percent of net worth during the first five years of plant operation at full nominal capacity.

(c) Income statements for a cold-soda hardwood pulp mill having a capacity of 100 tons per day and built in connection with an existing paper mill indicates that a paper producer dependent on purchases of market pulp can expect a return of 10.2 percent profit on mill investments. Since the capital amount is of moderate size, the parent organization would be likely to have several alternative paths of investment and these must be compared, technically as well as financially, in order to draw a specific conclusion on this project.

13. These findings indicate that production of newsprint at a mill located in northern Wisconsin appears economically questionable, whereas expansion of production of sulfate and cold-soda pulps from hardwoods appears to be both technically and economically feasible. Because of the reserve capacity presently available in the pulp, paper, and board industries, however, the timing of new plant construction or expansion to meet anticipated long-run increases and demands is a matter of major importance.

14. In view of geographic differentials in wood costs, it is also possible that mill locations in areas of surplus wood such as northern Minnesota might be somewhat more promising than indicated above. Final determination of the desirability of production at any specific site necessarily must be based upon detailed plant location and market studies, and upon comparative data for the various areas in the United States and Canada where further expansion of the industry is possible.

CHAPTER I

THE MARKET OUTLOOK FOR NEWSPRINT AND OTHER PULP AND PAPER PRODUCTS

This chapter presents a brief indication of potential demands in the United States for: A. Newsprint and B. Other grades of paper and board. With the continuing growth of population and rapid expansion of the Nation's economy, markets for practically all products of the pulp and paper industry have been growing rapidly. Further major increases in consumption also are anticipated in the years ahead.

Market factors alone will not of course determine the future feasibility of newsprint production or of any other grade of paper and board in any particular area such as the Lake States. But the magnitude of future market expansion certainly will have a major influence on the profitability of production of pulp and paper in all competing regions.

A. Newsprint

Consumption of Newsprint has Nearly Doubled Since 1940

Newsprint consumed in the United States reached a postwar peak of about 6.8 million tons in 1956, as shown in figure 1 and appendix table 1, or roughly double the amount used just prior to World War II. Part of this very considerable expansion of newsprint consumption is attributable to population growth. Much of it reflects a substantial increase in newspaper circulation, size, and frequency of publication which is reflected in a marked rise in per capita consumption of newsprint--from about 54

pounds per person in 1938 to 81 pounds in 1956. Close to 90 percent of the newsprint sold in the United States is used for newspapers, with the remainder used for periodicals and other miscellaneous purposes.

Further Large Increases in Newsprint Demands Expected

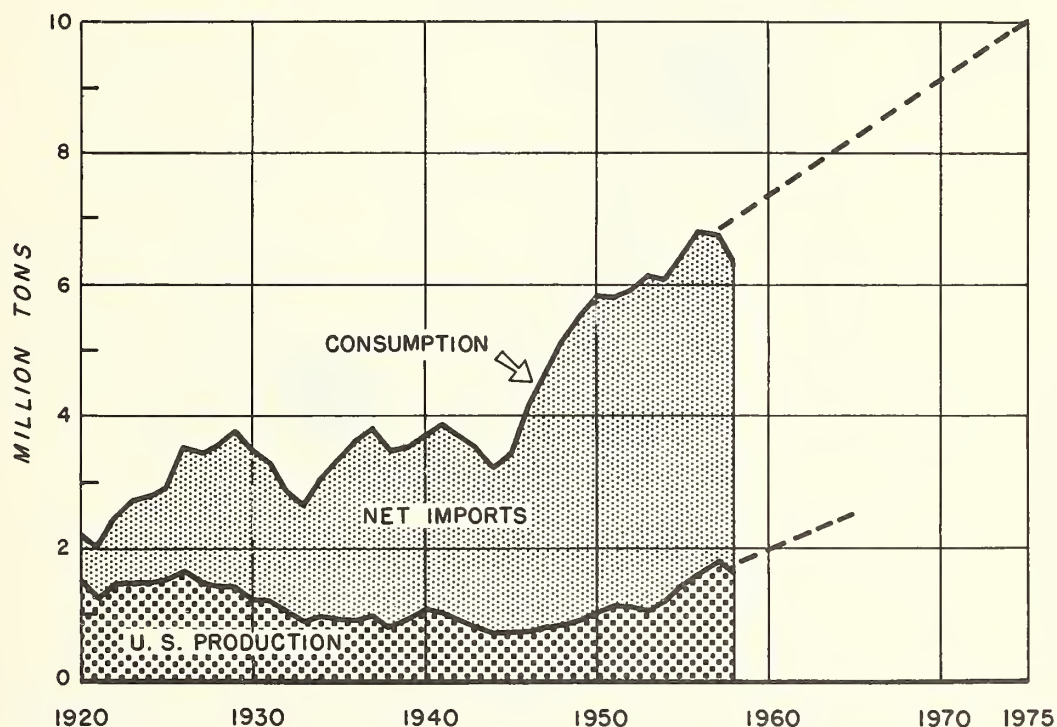
Consumption of newsprint in 1957 and 1958 dropped significantly below the trend level of demand.¹ Nevertheless, various projections of potential future demand for newsprint all point to major long-run expansions of newsprint markets in both the United States and other parts of the world. Some of these projections for the United States, summarized in table 1 and illustrated in figure 1, suggest a market demand of close to 8.3 million tons by 1965. This would be roughly 22 percent above consumption in 1957. By 1975 potential demands are expected to reach 10 million tons, or 47 percent above consumption in 1957.

Newsprint Consumption Concentrated in the Central and Northeastern States

The concentration of newsprint consumption in the densely populated and heavily industrialized States of the northeastern and central regions is illustrated in table 2 and figure 2, which show newsprint used in

¹The trend level of demand is defined as the demand in a given year that would be expected from a projection of historical relationships between consumption and major economic factors such as Gross National Product and population.

Newsprint consumption and potential demand in the United States



SOURCE: U.S. Departments of Commerce and Agriculture

FIGURE 1

publishing in 1954. Consumers in the Central region accounted for about 20 percent of the total newsprint used in publishing, consumers in the Lake States 9 percent, and newsprint users in the Plains and Rocky Mountain States an additional 4.3 percent.

Thus publishers in the three regions where newsprint produced in the Lake States would normally be marketed account for about one-third of the newsprint used in the United States. This now amounts to more than 2 million tons annually.

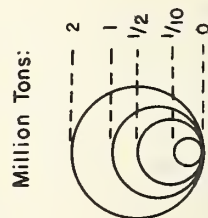
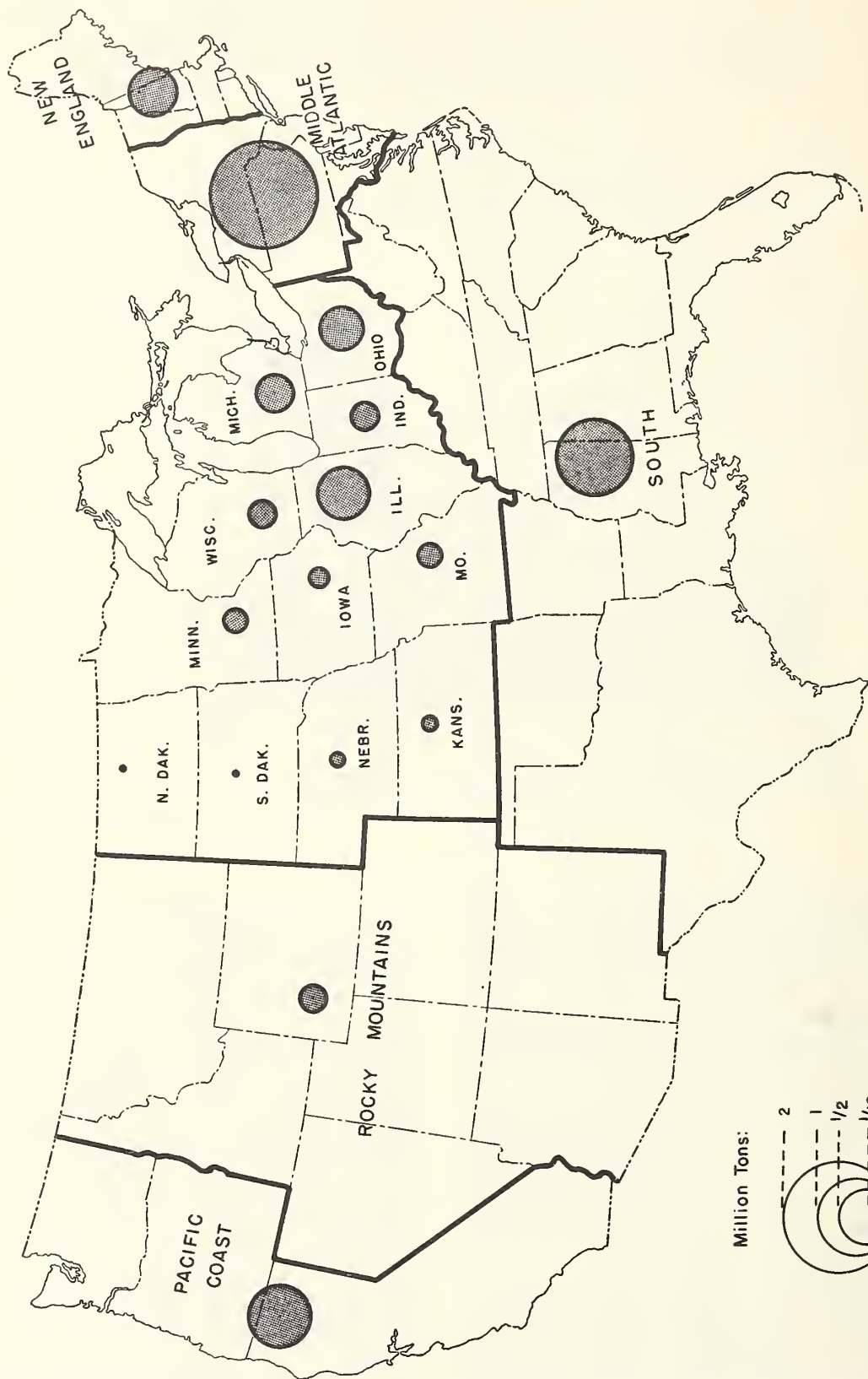
A modern newsprint mill such as appraised in Chapter IV might be expected to produce approximately 150,000 tons annually. The marketing of this additional supply of newsprint

would depend in part upon such factors as the rate of growth of future newsprint markets and the nature of business connections which a new plant might have with an existing producer or consumers of newsprint. It is nevertheless assumed that production of a new mill located in the northern Lake States could in time be successfully marketed in such newsprint consuming centers as Madison, Chicago, Kansas City, and other population centers of the Lake, Central and Plains regions.

Canada Supplies Most of the Newsprint Used in the United States

The major part of the newsprint used in the United States has long

NEWSPRINT CONSUMPTION IN PUBLISHING, 1954



SOURCE: BUREAU OF THE CENSUS

FIGURE 2

Table 1.--Projections of potential demand for newsprint in the United States and the World
(Million tons)

Estimating agency	1957 actual consumption ¹	Projections	
		1965	1975
United States			
U. S. Forest Service ²	6.8	--	10.0
U. S. Dept. of Commerce ³	6.8	8.3	--
American Newspaper Publishers Association ⁴ .	6.8	8.6	--
Royal Commission on Canada's Economic Prospects ⁵	6.8	7.9	9.5
Stanford Research Institute ⁶	6.8	7.3	8.6
World			
Royal Commission on Canada's Economic Prospects ⁵	13.7	17.3	22.5

¹ Data for U. S. from Bureau of the Census, U.S. Department of Commerce. Facts for Industry. Data for the World from U.S. Department of Commerce (see footnote 3 below).

² Forest Service, U.S. Department of Agriculture. Timber Resources for America's Future, 1958.

³ Business and Defense Services Administration, U.S. Department of Commerce. Pulp, Paper, and Board Supply-Demand, Newsprint Outlook. Report of the Committee on Interstate and Foreign Commerce, 85th Congress, 2d Session. House Report No. 1868. 1958.

⁴ American Newspaper Publishers Association. Newsprint - A Forward Look to 1965. 1957.

⁵ Royal Commission on Canada's Economic Prospects. The Outlook for the Canadian Forest Industries. 1957

⁶ Stanford Research Institute. America's Demand for Wood, 1928-1975. 1954.

been supplied by Canadian newsprint mills. Figure 3 indicates the general location and size of the presently operating newsprint mills in Canada and in the United States. Appendix table 2 shows the capacity of each of these mills at the end of 1958.

In the important consuming regions of the eastern United States newsprint supplies are obtained mainly from the Canadian Provinces of Quebec and Ontario. The South, on the other hand,

is now self-sufficient in newsprint as a result of the recent major expansion of newsprint production in this region. Five southern mills currently have a total capacity of about 1.2 million tons annually, as shown in appendix table 2. In the West, newsprint mills in British Columbia, Oregon, and Washington have more than sufficient capacity to supply the newsprint markets of the western regions.

Table 2.--Newsprint consumed in publishing in the United States, by Region and State, 1954

Region and State	Quantity ¹	Proportion of total	Region and State	Quantity ¹	Proportion of total
	<u>Thousand tons</u>	<u>Percent</u>		<u>Thousand tons</u>	<u>Percent</u>
New England.....	354.9	6.2	South.....	990.9	17.4
Middle Atlantic.	1,800.4	31.6	Plains:		
Lake:			North Dakota	7.2	0.1
Minnesota.....	111.7	2.0	South Dakota	8.5	0.2
Michigan.....	266.4	4.6	Nebraska....	41.7	0.7
Wisconsin.....	135.6	2.4	Kansas.....	49.6	0.9
Total.....	513.7	9.0	Total.....	107.0	1.9
Central:			Rocky Mountain	139.9	2.4
Ohio.....	383.4	6.7	Pacific Coast.	656.3	11.5
Indiana.....	128.3	2.3	Total U.S....	5,705.2	100.0
Illinois.....	436.4	7.6			
Iowa.....	78.1	1.4			
Missouri.....	115.9	2.0			
Total.....	1,142.1	20.0			

¹ Excludes about 398,000 tons of newsprint used in other industries--largely the paper converting industries.

Source: Bureau of the Census, U.S. Department of Commerce. Census of Manufactures, 1954.

The dependence of United States publishers on imported newsprint increased rapidly after about 1925, as illustrated in figure 1 and appendix table 1. Imports in 1925 represented 48 percent of total consumption. By 1940 imports had risen to about 72 percent of the total, and in 1949 reached a peak of nearly 83 percent of U. S. consumption. With the recent expansion of domestic production, however, imports have dropped to about 74 percent of the total U. S. market for newsprint.

This dependence on Canada for newsprint resulted from a number of factors, including abundant supplies of the long-fiber and resin-free species of spruce and balsam fir that for technical reasons have been preferred for newsprint manufacture. Other favorable factors included relatively low cost power in Canada, ample supplies of water, the duty-free status of newsprint in contrast to other grades of paper and paperboard protected by tariffs, a rate of exchange that generally favored Canadian

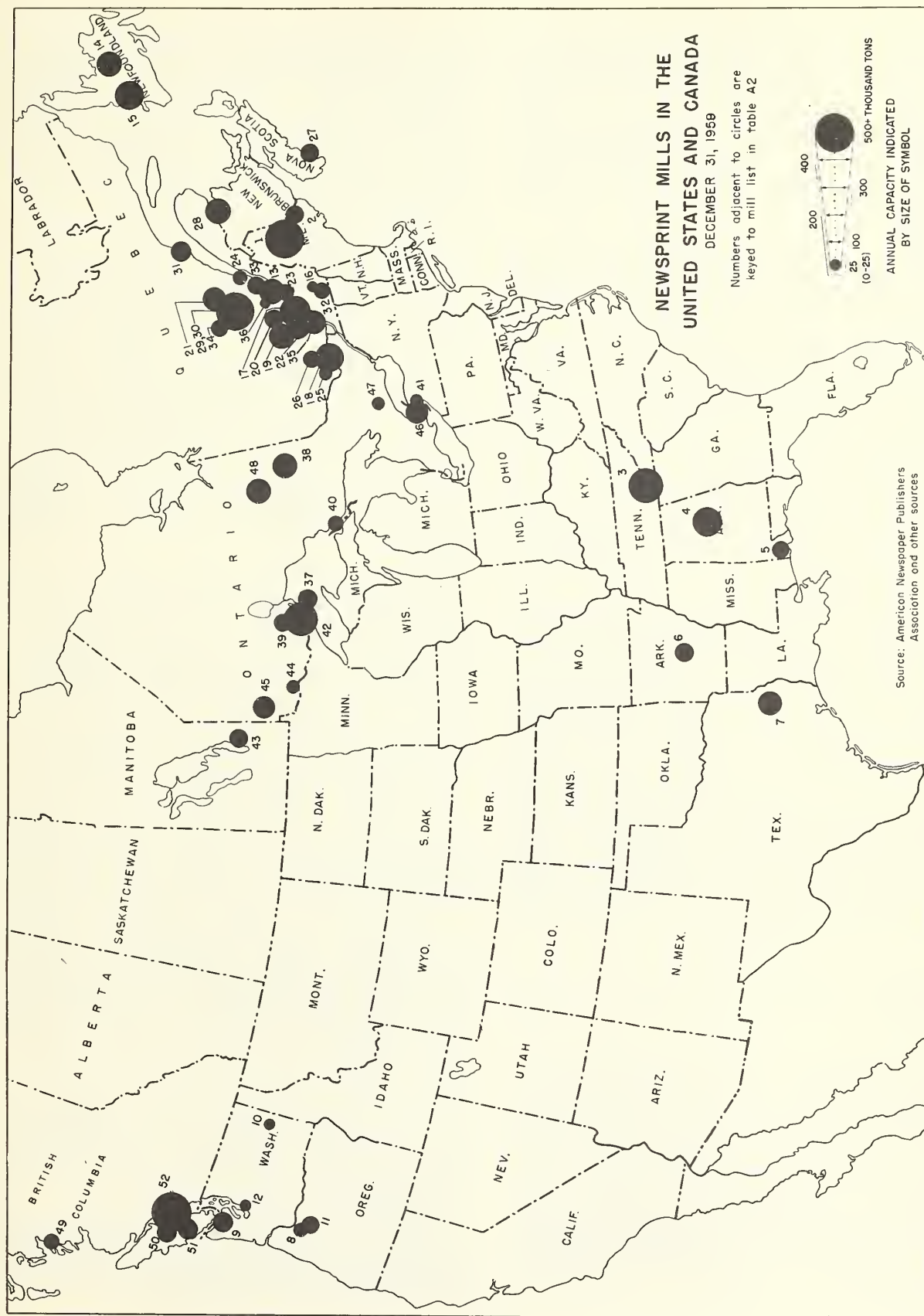


FIGURE 3

producers, and nearness to major markets in the Eastern United States. Because of such factors the spectacular expansion of the pulp and paper industry in the United States until recently was concentrated on grades of paper and board other than newsprint.

U. S. Newsprint Production Increasing

Production of newsprint in U. S. mills reached a low point of 721 thousand tons in 1944, as illustrated in figure 1. With the recent construction of the new mills in the South, however, and some plant expansion in other regions domestic production of newsprint has steadily risen to 1.8 million tons in 1957. Plant capacity in the United States at the end of 1958--located as shown in figure 3 and appendix table 2--is estimated at 2.4 million tons.

This recent expansion of newsprint production in the United States has been based chiefly on use of southern pine and to a lesser degree on increased use of the more conventional softwood species such as spruce, fir, and western hemlock. However, hardwoods also have entered the picture as a component of newsprint--notably at the Great Northern Paper Company in Maine and more recently at the Bowaters plant in Tennessee and at the Coosa River Newsprint Company in Alabama.

Current Capacity in Excess of Demand

In most of the postwar years since 1945 shortages of newsprint have been characteristic in both the United States and other parts of the world. This was in marked contrast to the record of the 1930's when production in North America averaged only about two-thirds of capacity, as shown in appendix table 3. In the 1920's production averaged roughly 85 percent of capacity.

In recent years capacity of the newsprint industry in Canada and the United States, and in various other countries of the world, has been built up at a fairly rapid pace. Up to 1957 demand nevertheless equaled or exceeded the rising capacity, as shown in table 3.

This supply-demand situation changed, however, in 1957 and 1958 as a result of a pronounced drop in demand and the continuing rise in plant capacity. Thus in 1958 newsprint production of 1.7 million tons in the United States amounted to only 82 percent of the estimated domestic annual capacity of 2.1 million tons for that year, as shown in appendix table 3. In Canada production of 6.1 million tons in 1958 equaled 84 percent of the estimated capacity of 7.3 million tons.

For Canada and the United States combined, capacity in 1958 exceeded consumption plus overseas shipments by about 1.6 million tons, as shown in table 3. Capacity in these countries also exceeded the trend level of demand in 1958 in the United States and Canada plus overseas shipments by nearly 1.0 million tons.

Further plant expansions by 1960 are expected to raise newsprint plant capacity by an additional several hundred thousand tons in both the United States and in Canada to a total of about 10.1 million tons, as shown in table 3. While demands in North America and overseas may also be expected to increase, continuing reserve capacity is anticipated. Even if consumption in 1960 in the United States and Canada were to rise to the trend level of demand as estimated by the Department of Commerce², with overseas shipments of 1 million tons, unused capacity in 1960 would approximate 1.2 million tons.

²Business and Defense Services Administration, U. S. Department of Commerce, Pulp, Paper and Board Supply-Demand, Newsprint Outlook, House Report No. 1868, 85th Congress, 2d session, 1958.

Table 3.--Newsprint consumption, capacity and shipments to overseas, United States and Canada, selected years 1940-1960

(Thousand tons)

Year	Consumption				Capacity			Reserve capacity ¹
	United States	Canada	Overseas shipments	Total	United States	Canada	Total	
1940.....	3,739	185	892	4,816	1,081	4,716	5,797	981
1945.....	3,451	201	704	4,356	981	4,672	5,653	1,297
1950.....	5,863	355	223	6,441	992	5,227	6,219	* 222
1955.....	6,485	430	911	7,826	1,409	6,064	7,473	* 353
1956.....	6,807	477	875	8,159	1,625	6,243	7,868	* 291
1957.....	6,768	457	971	8,196	1,921	6,756	8,677	481
1958.....	6,501	434	867	7,802	2,100	7,275	9,375	1,573
1960.....	² 7,325	² 520	² 1,000	8,845	2,475	7,600	10,075	1,230

¹ Items marked with asterisk show excess of consumption over rated capacity.

² Trend level of demand; may exceed actual consumption.

Source: Consumption in the United States 1955-58, Bureau of the Census, U. S. Department of Commerce, Facts for Industry.

Consumption in the United States 1940, 1945 and 1950; capacity in the United States and Canada 1958 and 1960; and trend level of demand in 1960 Business and Defense Services Administration, U. S. Department of Commerce, Pulp, Paper, and Board Supply-Demand, Newsprint Outlook, Report of the Committee on Interstate and Foreign Commerce, 85th Congress, 2d Session, House Report No. 1868, 1958.

Consumption in Canada 1940-58, American Newspaper Publishers Association, Newsprint Statistics, 1958, Newsprint Bulletin No. 11, February, 1959. Capacity in the United States and Canada, 1940-57, Newsprint Association of Canada, Annual Newsprint Supplement, April 1958.

For the world as a whole, the estimates of the Department of Commerce indicate that newsprint mill capacity of 15.5 million tons in 1958 was about 2.2 million tons above estimated actual production of newsprint, and 1.2 million tons more than the estimated "trend level" of world

demand.² The projections in this study by the Department of Commerce point to continuing world reserve capacity over the trend level of demand, partly

²Business and Defense Services Administration, U.S. Department of Commerce, Pulp, Paper and Board Supply-Demand, Newsprint Outlook, House Report No. 1868, 85th Congress, 2d session, 1958.

as a result of the prospective addition of about 1.4 million tons of world capacity between 1958 and 1960. The prospective world surplus of capacity over the trend level of demand in 1959 and in 1960 is estimated at approximately 1.7 million tons annually.

The increased capacity for newsprint production in North America and in the world as a whole indicate that for the next few years Canadian and U. S. producers will be able to meet rather substantial increases in newsprint demand. This reserve capacity in the industry is an important

consideration in the scheduling of further plant expansions. While the projections of potential demands summarized in table 1 indicate that further growth of the newsprint industry will be needed in the United States and/or Canada in the years ahead, the timing of such expansion is a matter of some uncertainty.

Newsprint Prices at All-time High

Average prices for newsprint in 1958 were quoted at \$134.40 per ton, as shown in appendix table 4. This was roughly 41 percent above prices

Table 4.--Wholesale price indexes for newsprint, paper excluding newsprint, paperboard, woodpulp, and all commodities, 1940-58

(1947-49 = 100)

Year	Newsprint	Paper excluding newsprint	Paperboard	Woodpulp	All commodities
1940.....	52.8	--	48.6	50.7	51.1
1941.....	52.8	--	54.7	56.0	56.8
1942.....	52.8	--	56.3	58.1	64.2
1943.....	57.8	--	60.6	58.2	67.0
1944.....	61.3	--	62.0	62.8	67.6
1945.....	63.6	--	64.6	63.5	68.8
1946.....	76.3	--	71.2	70.2	78.7
1947.....	92.6	93.7	99.2	95.6	96.4
1948.....	101.9	103.1	102.0	107.3	104.4
1949.....	105.5	103.3	98.8	97.0	99.2
1950.....	106.2	106.5	105.0	95.6	103.1
1951.....	115.5	120.4	131.8	114.4	114.8
1952.....	125.6	123.5	127.4	111.5	111.6
1953.....	131.1	123.7	124.3	109.0	110.1
1954.....	131.4	125.0	124.5	109.6	110.3
1955.....	131.6	129.3	127.1	112.9	110.7
1956.....	136.0	138.0	134.8	117.7	114.3
1957.....	139.7	142.9	136.3	118.8	117.6
1958 (Dec.).....	140.6	142.8	136.2	121.2	119.2

Source: Bureau of Labor Statistics, U.S. Department of Labor. Wholesale Prices and Price Indexes.

quoted in the period 1947-49, as shown in table 4. This increase was approximately the same as the rise of 43 percent in prices of paper other than newsprint, somewhat more than the 36 percent increase for paper-board, and substantially more than the rise of 21 percent for woodpulp and 19 percent for all commodity prices.

Newsprint sold in the United States has usually been sold by price zones, with prices quoted on a delivered basis with freight absorbed by the shipper. It is understood that the New York price, quoted at \$134.00 per ton in 1958, is generally applicable in the major cities of the Lake, North Central, and Middle Atlantic States. Differentials from this base price include an additional charge of \$1.00 per ton in the smaller cities of the central-lake region and somewhat higher charges in zones to the West. Thus in Denver, for example, newsprint prices are \$5.00 per ton more than the base price.

For the territory that might be supplied from newsprint mills located in the Lake States it is assumed that delivered prices would average about \$135.00 per ton.

Freight Charges on Newsprint an Important Competitive Factor

Rail freight charges make up a substantial portion of the delivered price of newsprint and freight charges are therefore an important factor in interregional competition. As shown in appendix table 4, rail freight charges from Three Rivers, Quebec, to New York City, for example, currently amount to about \$17.00 per ton, or 13 percent of the delivered price of newsprint in New York.

In the past several decades rail freight charges have increased somewhat more rapidly than the price of newsprint. In the early 1920's, for example, rail freight from Three Rivers to New York City made up about 8 percent of the delivered

price. This increased to about 16 percent in the depression years of the thirties, and in recent years has averaged roughly 12 percent of the delivered price.

Newsprint producers in the Lake States have a significant freight advantage in selling newsprint in such major consuming centers as Chicago, Illinois; Columbus, Ohio; Detroit, Michigan; and other midwestern cities. Some general indication of freight differentials, and areas where Lake States newsprint producers have a rail transportation advantage, are given in table 5.

This table shows, for example, that rail freight for newsprint shipped from northern Wisconsin to Chicago currently amounts to about \$8.60 per ton, compared with \$13.20 from western Ontario, \$15.00 from Pine Bluff, Arkansas, and \$18.60 from Coosa Pines, Alabama.

About two-thirds of the newsprint sold in the United States is shipped by rail, with water transportation accounting for most of the remaining tonnage. Water freight rates on newsprint have generally been lower than rail freight charges, but public rate information comparable to that for railroads is not available. Many water shipments of newsprint are forwarded in mill-owned or controlled vessels, or under rates determined by private negotiations. Considerable newsprint moves by water to ports on the Atlantic coast, but the seasonal character of waterborne shipments on the Great Lakes tends to limit the movement of newsprint by that route.

It is assumed for the economic analysis in Chapter IV that newsprint produced at a site in northern Wisconsin might be sold largely in Wisconsin, Chicago and other population centers in nearby States. This might be an optimistic assumption but on this basis it is estimated that freight charges would average about \$10.00 per ton.

Table 5.--Rail freight rates on newsprint between selected mill locations in the United States and Canada, and selected destinations in the United States, 1958

(Dollars per ton in carload lots of 40,000 pounds minimum weight)

Destination	Origin								
	Rhine- lander Wisconsin	Fort William Ontario	Sault Ste. Marie Ontario	Pine Bluff Arkansas	Coosa Pines Alabama	Ottawa Ontario	Milli- nocket Maine	Three Rivers Quebec	Port Angeles Washing- ton
Madison, Wisconsin....	7.20	13.20	8.80	*16.20	¹ 26.80	29.20	*26.40	29.20	48.40
Chicago, Illinois.....	8.60	13.20	9.60	*15.00	*18.60	23.00	*25.00	23.00	50.40
St. Louis, Missouri....	*12.40	15.60	13.60	*11.00	*13.20	27.20	*27.80	27.20	46.80
Detroit, Michigan.....	13.60	20.60	12.80	*25.00	*28.00	19.60	*21.80	19.60	54.40
Columbus, Ohio.....	16.00	23.00	15.60	*23.20	¹ 19.20	21.80	*24.00	21.80	58.20
New York, New York....	22.00	27.40	22.40	*31.00	*24.20	17.40	16.00	17.40	65.40
Denver, Colorado.....	23.00	24.20	27.20	22.60	*28.40	46.00	39.60	46.00	24.20
Billings, Montana.....	36.60	43.20	35.60	40.00	47.80	55.80	58.20	55.80	24.20

¹ Class rate.

*50,000 pounds minimum weight.

Source: Compiled by the Traffic Management Branch, Commodity Stabilization Service, U.S. Department of Agriculture from interstate rail freight rates filed with the Interstate Commerce Commission.

B. Markets for Other Paper and Board

In addition to newsprint, there are various possibilities for profitable production of other grades of pulp, paper, and board in the Lake States region. Some indication of markets for these products is therefore presented in the following section.

Consumption of Paper and Board Products Other than Newsprint also Increasing Rapidly

Consumption of practically all types of paper and board has been expanding rapidly in the United States, and for certain grades this expansion has been at much faster rates than for newsprint. Since nearly all of the paper and board consumed in the United States (excepting newsprint) is produced in U.S. mills, it is evident from the production record that for at least the past few decades the U.S. pulp and paper industry has seen greater opportunities for profits in production of grades other than newsprint. This has been particularly true in the Lake States where mills that once produced newsprint have gradually shifted to other grades of paper or board.

Figures 4 and 5 illustrate the sharp increases in past consumption of most grades of paper and board in the United States. In 1957 total consumption of all grades of paper and board (excluding newsprint) amounted to 28.5 million tons, including 13 million tons of paper and 15.5 million tons of paperboard. This level of consumption in 1957 was 2.2 times greater than in 1940--or about the same as the increase for newsprint.

Part of the increases in consumption of paper and board is attributable to the spectacular growth of population and national income in the United States. Part is the result of creation of new or improved products of the

industry, new uses for paper and board, and the substitution of paper and board for lumber, cotton, and other competing materials.

Favorable Market Location for Lake States Mills

Major consuming markets for most paper and board products, as in the case of newsprint, are concentrated in the densely populated and highly industrialized Central, Lake, and Middle Atlantic regions. Table 6 demonstrates considerable concentration in these regions of the "converting" industries which produce such items as paper bags, envelopes, and boxes. Consumption of paper in the printing and publishing industries, and use of building paper and board in construction also are highly concentrated in these same market areas.

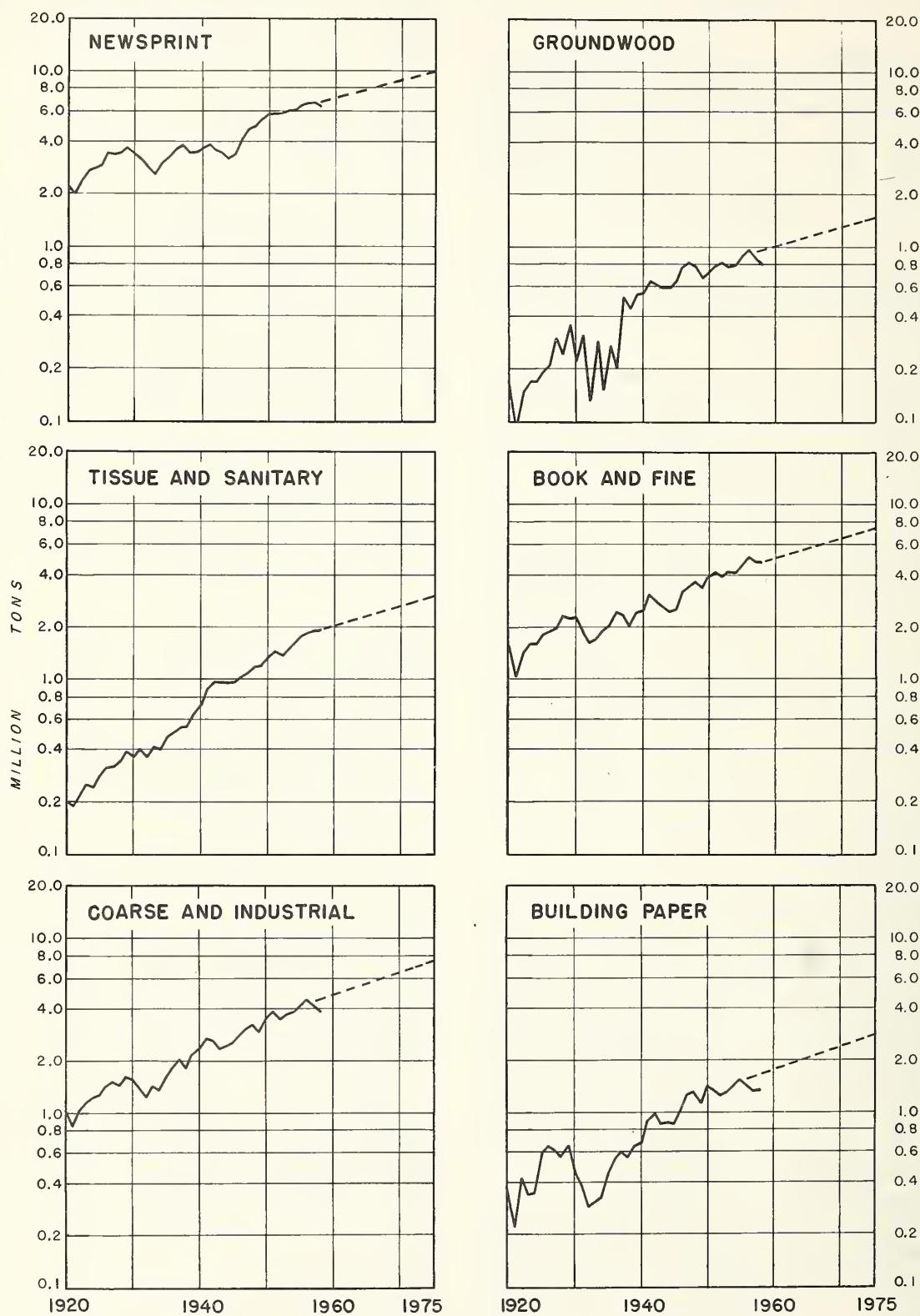
Further Expansion of Demands for Paper and Board Anticipated

Projections of potential demands for paper and board products made by various agencies all point to substantial expansion of U. S. markets in future years.

Figures 4 and 5 illustrate projections recently made by the U. S. Forest Service to the year 1975 by major grades of paper and board. In the aggregate, these projections show a rise in potential demand of 71 percent for paper (other than newsprint) between 1957 and 1975, and a rise of 79 percent for board.

Table 7 shows these Forest Service estimates by individual grades, together with similar projections of the Department of Commerce to the year 1965. As indicated therein, the largest projected increases in potential demand in terms of tonnage, are for container-board, bending board, coarse and industrial papers, and book and fine papers.

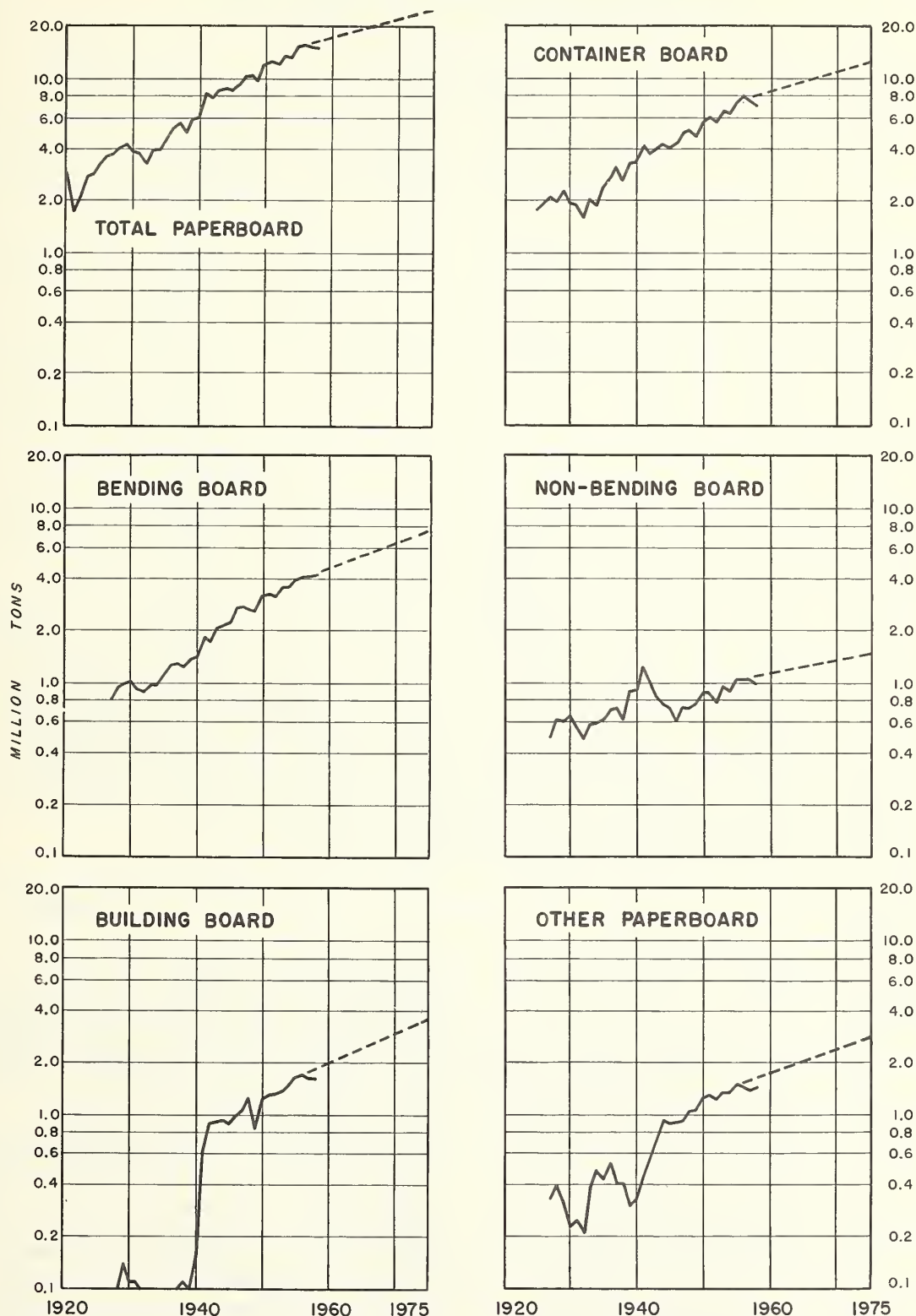
Paper consumption and potential demand in the U. S.



SOURCE: U. S. Departments of Commerce and Agriculture

FIGURE 4

Paperboard consumption and potential demand in the U. S.



SOURCE: U. S. Departments of Commerce and Agriculture

FIGURE 5

Table 6.--Consumption of paper (excluding newsprint) and paperboard in converting industries,¹ by Region, 1954

Region	Paper (excluding newsprint)		Paperboard	
	Amount consumed	Percent of total	Amount consumed	Percent of total
	<u>Tons</u>	<u>Percent</u>	<u>Tons</u>	<u>Percent</u>
New England.....	450,685	9.1	798,586	7.6
Middle Atlantic.....	1,264,103	25.4	3,015,560	28.7
Lake.....	796,775	16.0	1,352,832	12.9
Central.....	601,322	12.1	2,512,600	24.0
South.....	1,345,275	27.0	1,553,143	14.8
Rocky Mountain.....	8,887	0.2	177,406	1.7
Pacific Coast.....	510,346	10.2	1,078,364	10.3
Total United States.....	² 4,977,393	100.0	³ 10,488,491	100.0

¹ Industries engaged in manufacturing products such as envelopes, paper bags, coated papers and paperboard boxes from purchased paper and paperboard.

² Represents 42.3 percent of total consumed. Does not include paper consumed in the printing and publishing industry, construction, etc.

³ Represents 76.9 percent of total paperboard consumed.

Source: Bureau of the Census, U.S. Department of Commerce, 1954 Census of Manufactures.

Capacity Currently in Excess of Production

Plant capacity for most grades of paper and board was substantially higher than actual production in 1958, as shown in table 8. However, capacity was not greatly in excess of the "trend level" of demand except for "all other board," according to estimates of the Department of Commerce also shown in table 8. In 1958 plant capacity for paper other than newsprint amounted to 14.5 million tons, or 0.3

million tons above the "trend level." Capacity of board mills amounted to 19.5 million tons, or 2.3 million tons above the estimated "trend level" of demand.

As in the case of newsprint, it is anticipated that the long-run growth of the industry, such as projected in figures 4 and 5, sooner or later will require resumption of new plant construction or plant expansions in all major segments of the industry. It is also to be expected that the diversified pulp and paper industry

Table 7.--Projections of potential demands for paper and board in the United States

(Million tons)

Grade classes	Consumption 1957	Projected demand			
		1965		1975	
		Quantity	Percent increase over 1957	Quantity	Percent increase over 1957
Newsprint.....	6.8	8.3	22	10.0	47
Other paper:					
Groundwood paper.....	.9)	7.0)	23	1.5	67
Book and fine.....	4.8)	7.0)	23	7.5	56
Coarse & industrial....	4.1	5.7	39	7.4	80
Tissue and sanitary....	1.9	2.6	37	3.0	58
Building paper.....	1.3	2.2	69	2.8	115
Total.....	13.0	17.5	35	22.2	71
Board:					
Container board.....	7.4	10.2	38	12.5	69
Bending board.....	4.1	6.8	66	7.5	83
Building board.....	1.6	2.3	44	3.5	119
Nonbending board.....	1.0)	3.5)	46	1.5	50
Other board.....	1.4)	3.5)	46	2.8	100
Total.....	15.5	22.8	47	27.8	79
All paper and board.....	35.3	48.6	38	60.0	70

Source: Consumption 1957. Based on production plus net imports as reported by the U. S. Department of Commerce.

Projected demand 1965. Business and Defense Services Administration, U. S. Department of Commerce, Pulp, Paper, and Board Supply-Demand, Newsprint Outlook. Report of the Committee on Interstate and Foreign Commerce, 85th Congress, 2d session, House Report No. 1868. 1958.

Projected demand 1975, Forest Service, U. S. Department of Agriculture, Timber Resources for America's Future. 1958.

In the Lake States will continue to share to some degree in any such general expansion of markets for pulp, paper, and board products.

Large Expansion in Woodpulp Consumption Required

Consumption of woodpulp in the United States has been increasing

Table 8.--Estimated production, demand, and capacity for paper (excluding newsprint) and board in the United States, 1958

(Thousand tons)

Grade	Production	Trend level of demand ¹	Capacity ²	Surplus ³
Paper (excluding newsprint):				
Printing paper.....	4,031	4,235	4,600	365
Fine paper.....	1,568	1,600	1,700	100
Coarse and special industrial paper.....	4,242	4,720	4,500	*220
Sanitary and tissue paper...	1,961	1,960	2,000	40
Building paper.....	1,349	1,700	1,700	--
Total.....	13,151	14,215	14,500	285
Board:				
Building board.....	1,630	1,775	2,300	525
All other board.....	14,293	15,420	17,200	1,780
Total.....	15,923	17,195	19,500	2,305
Total paper (excluding newsprint) and board.....	29,074	31,410	34,000	2,590

¹ Projection based on past relationships between consumption and economic activity. For detail see information in source shown below.

² Annual capacity based on 310 working days for paper, 312 days for building board and 313 days for other board.

³ Excess of capacity over trend level of demand, or deficit for starred item.

Source: Production. Bureau of the Census, U.S. Department of Commerce, Facts for Industry. Pulp, Paper and Board. Preliminary estimates.

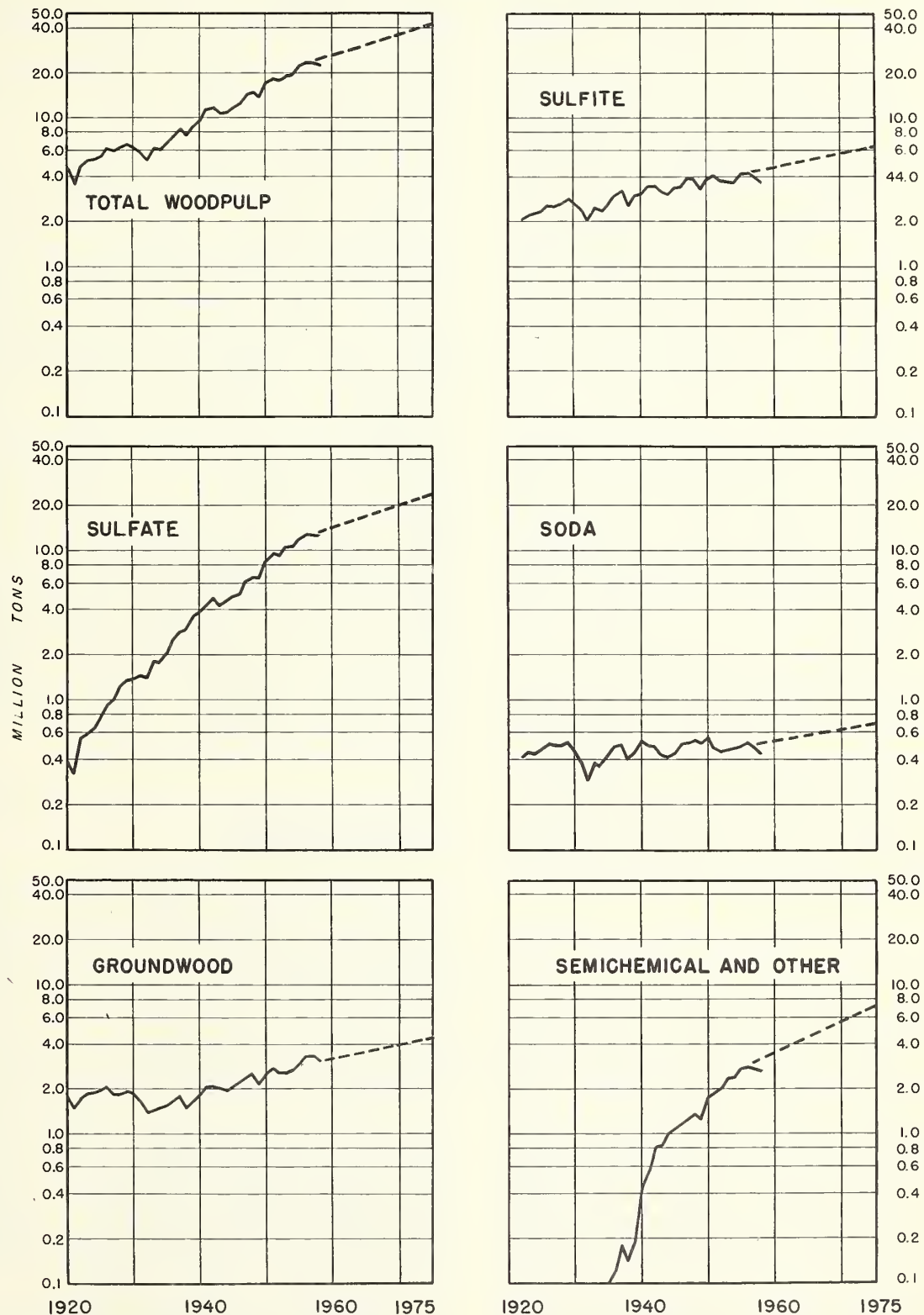
Trend demand and capacity. Business and Defense Services Administration, U.S. Department of Commerce, Pulp, Paper, and Board Supply-Demand, Report of the Committee on Interstate and Foreign Commerce, 85th Congress, 1st session, House Report No. 573, June 1957.

rapidly, as illustrated in figure 6. In 1957 consumption amounted to 23.3 million tons, or double the level of consumption in 1946. New woodpulp is by far the principal source of fiber used by the paper and board industry. Thus in 1957 new woodpulp accounted for 70 percent of the fibrous materials

used by the paper and board industries and other pulp consumers, waste paper 27 percent, and other materials the remaining 3 percent.

In recent years, consumption of sulfate and semichemical pulps has expanded more rapidly than use of other pulps, as illustrated in figure 6.

Woodpulp consumption and potential demand in the U.S.



SOURCE: U.S. Departments of Commerce and Agriculture

FIGURE 6

Currently more than half of the woodpulp consumed in the United States, or roughly 13 million tons, is sulfate pulp. A small but increasing proportion of this sulfate pulp is produced from hardwood species. Consumption of semichemical pulps, produced largely from hardwoods, has also climbed steeply and now amounts to about 1.6 million tons annually. Consumption of sulfite and groundwood pulps has shown only modest increases in recent years, while output of soda pulp has shown little change.

Demands for woodpulp are expected to increase fairly rapidly in the United States in the years ahead, as illustrated by the Forest Service projections shown in figure 6, particularly for sulfate and semichemical pulps. For all grades combined these projections indicate an average increase of roughly 80 percent in woodpulp demands between 1957 and 1975.

Currently there is a fairly substantial excess of capacity for production of woodpulp in the United States, according to estimates of the United States Pulp Producers Association.³ This reserve capacity is of major short-term importance although it does not appear to be overly large in comparison with the major increase in pulp demands that are projected over the next decade.

Part of Woodpulp Sold as Market Pulp

Most of the woodpulp consumed in the United States is produced and used in "integrated" mills which manufacture paper or board as well as woodpulp. In 1956, for example, about 85 percent of all the pulp consumed was produced and used at such mills. However, about 2.7 million tons of the woodpulp produced in United States mills in 1956 was sold

as "market" pulp in domestic and export markets, as shown in table 9. About a third of this market pulp was sulfate pulp, another third dissolving pulp, and the balance sulfite and other grades of pulp.

An additional 2.3 million tons of pulp was imported in 1956, of which 1.7 million tons was considered market pulp.⁴ About 1.3 million tons of the imported market pulp was obtained from Canada and 0.4 million tons from Europe. Paper grades of sulfate pulp accounted for about half of the imports, and sulfite and groundwood pulps most of the remainder.

The total supply of market pulp available in 1956 thus amounted to about 3.8 million tons, of which paper grades accounted for 3 million tons and dissolving pulp the remainder. This level of use for paper grades was not greatly different from consumption in 1945 and subsequent postwar years. This in large part reflects the trend toward integration and mergers in the pulp and paper industry. There has been a marked trend, however, toward increased production of bleached sulfate market pulp.

Potential Markets for Pulp Produced in the Lake States

As in the case of newsprint and other grades of pulp, paper, and board, consumers of market pulp are largely concentrated in the northeastern and central regions. From the standpoint of location, Lake States producers might have a long-run advantage in supplying a portion of these markets.

Perhaps of greater importance to the industry in the Lake States, however, is the possibility of producing and using larger quantities of hardwood pulps within that region. Paper and board mills in the Lake States do not produce all of the pulp needed

³United States Pulp Producers Association, Inc., Results of the 1958 Woodpulp Capacity Survey, April 1958.

⁴United States Pulp Producers Association, Inc., Trends in the United States Pulp Market, 1937-1957.

Table 9.--Production, shipments, and imports of woodpulp in the United States, by type of pulp, 1956

(Thousand tons)

Type of pulp	Production			Imports
	Total ¹	Transfers to own use ²	Domestic and export shipments ³	
Sulfate:				
Bleached.....	3,659	2,976	672	729
Semibleached.....	489	400	88	--
Unbleached.....	7,983	7,823	149	304
Total.....	12,131	11,199	909	1,033
Semichemical.....	1,547	1,545	(⁴)	--
Sulfite.....	2,686	2,068	609	797
Special alpha and dissolving...	941	3	917	174
Groundwood.....	3,041	2,924	113	273
Other ⁵	1,785	1,673	⁶ 113	55
Total all types.....	22,131	19,412	2,661	2,332

¹ Columns do not add to total because of changes in stocks.

² Includes transfers to affiliated domestic mills.

³ Shipments to domestic mills not under the same ownership control as the seller.

⁴ Withheld to avoid disclosing figures for individual companies.

⁵ Includes soda, defibrated or exploded, and screenings and damaged pulps.

⁶ Includes small quantities of semichemical pulp.

Source: Bureau of the Census, U.S. Department of Commerce, Facts for Industry, Pulp, Paper and Board and United States Imports of Merchandise for Consumption.

for the wide variety of grades produced in that area. In 1957, for example, Lake States mills used approximately 800,000 tons of imported pulp, obtained mainly from Canada and consisting largely of long-fiber chemical pulp made from softwoods. Pulp mills within the region produced

an additional 1 million tons of softwood pulps and 0.9 million tons of hardwood pulps.

Much progress has already been made in the Lake States in use of hardwood pulps. It is believed that additional quantities of hardwood pulps also might be used in various blends

both as a partial substitute for soft-wood pulps and a means of expanding output of the local industry.

The prices received for woodpulp vary considerably depending on such factors as type and quality of the pulp. In view of the special reference to bleached hardwood sulfate market pulp in Chapter IV, illustrative price quotations for this grade as published by the Paper Trade Journal are tabulated below:

Year:	Price per ton (Delivered basis, first week of July)
1954.....	\$140.00
1955.....	145.00
1956.....	150.00
1957.....	150.00
1958.....	152.00

Similar price quotations are not available for cold-soda pulps. Not only is this a new product but under present technology cold-soda pulp is not a market pulp but is used to best advantage in integrated paper or board plants.

The foregoing chapter has pictured the spectacular recent expansion of the pulp, paper, and board industries in the United States, and has indicated the likelihood of further major expansion of markets for most of the products of these industries. With this background, attention is next directed toward the technical possibilities of using greater proportions of hardwoods in meeting anticipated demands for newsprint and for other grades of paper and board.

CHAPTER II

TECHNICAL SUITABILITY OF HARDWOOD PULPS FOR NEWSPRINT AND OTHER PRODUCTS

In recent years use of hardwood pulpwood in the United States has been increasing rapidly. Between 1945 and 1957, for example, production rose from 2.2 million cords to 6.2 million cords, or 17.4 percent of the total pulpwood used, as shown in appendix table 5.

Essentially all of this large quantity of hardwood was used for grades of paper and board other than newsprint. Nevertheless, laboratory tests and the growing body of commercial experience point to significant possibilities in use of hardwoods for newsprint. This chapter therefore presents a brief analysis of some of the technical developments and possibilities for production of both newsprint and hardwood pulps to be used in other grades of paper and board.

A. Newsprint

High-Speed Machines Required for Newsprint Production

Although newsprint is considered one of the lower grades of printing papers, it is a specialized product. It is manufactured on the largest of paper machines operating at very high speeds and at the highest production rates within the printing paper category.

Any new newsprint mill to be competitive must use modern, high-speed paper machines. Efficiencies and labor economics on modern wide machines are proven. Trim losses are materially reduced in comparison with narrower machines. Capital invest-

ments per ton of output also are reduced, assuming equal quality machinery.

Several commercial newsprint machines are now running continuously and efficiently at speeds in excess of 2,000 feet per minute. A plant having two such modern machines with a trim width of approximately 210 inches has a potential capacity of 500 tons of daily production.

Softwood Pulp Mixtures Mainly Used for Newsprint

Nearly all newsprint made on high-speed machines is now made of a mixture of 70 to 80 percent groundwood pulp and 20 to 30 percent sulfite or sulfate pulp. These pulps currently are made almost entirely from softwoods, largely white and black spruce, balsam and other true firs, western hemlock and southern pine.

The groundwood pulps are made by pressing wood against a grindstone running in water showers and partly submerged in a mass of pulp. This process gives close to the maximum in wood conversion, and the yield of pulp obtained is 90 percent or more of the weight of the wood used. Groundwood pulp has low strength, but it imparts to printing papers bulkiness, softness, opacity, finish, and other desirable qualities.

The chemical pulp conventionally used in making newsprint in the Northern and Western States and in Canada is produced by the sulfite process. This process employs an acid chemical solution usually consisting of calcium bisulfite and sulfurous acid.

Softwoods relatively low in resin content and light in color are used, and for making newsprint the pulp is not bleached. Softwood sulfite pulp of newsprint grade contains longer fibers and is stronger than groundwood pulp. This chemical pulp imparts strength to the paper and provides a network of fibers to hold the groundwood pulp.

Sulfate pulp is used for the strong chemical pulp component of southern pine newsprint. The sulfate process uses an alkaline solution of sodium hydroxide and sodium sulfide, and can be used to pulp practically all woods, including resinous species. The yield of sulfate pulp, like that from the sulfite process, is less than half the dry weight of wood used. Sulfate pulp has a brown color and therefore must be bleached to a satisfactory whiteness.

Hardwood Semichemical Type Pulp Suitable for Use in Newsprint

Three pulping processes--(1) the chemigroundwood process, (2) the neutral sulfite semichemical process, and (3) the cold-soda process--also are of considerable interest because of their possible application in pulping hardwoods for newsprint, as well as for other grades of paper and board. Pulp yields from these processes are high and the pulps produced can be made stronger than groundwood pulps.

Chemigroundwood pulp--The chemigroundwood process involves grinding billets that have been pretreated with a chemical solution under pressure and elevated temperature. The cooking liquor used is similar to that used in the neutral sulfite semichemical process, mentioned below, and hardwood chemigroundwood pulp can be made to resemble pulp made by the neutral sulfite semichemical process.

The strength and other properties of chemigroundwood pulp vary with the degree of chemical treatment. Thus with mild treatment, soft bulky

pulps with medium strength and with fiber length distribution comparable to softwood groundwood pulp can be obtained. With stronger treatment, pulp strength can be increased although yields are lower. The yield of chemigroundwood pulp from hardwoods is 85 to 90 percent by weight. Energy consumption in grinding is low and there is usually no necessity for bleaching pulp to be used in making newsprint.

The chemigroundwood process has been used commercially in one newsprint mill in the United States for the past several years. The woods used include both aspen and mixed northern hardwoods.

Neutral sulfite semichemical pulps--The neutral sulfite semichemical process, developed some years ago, has been extensively used in the manufacture of corrugating board. This process consists of a mild chemical treatment to soften the wood chips, followed by mechanical refining to complete fiber separation. The treating solution contains three or four parts of sodium sulfite to one of sodium carbonate.

Semichemical hardwood pulp suitable for use in newsprint can be obtained in yields from 70 to 90 percent for most hardwoods, and in the case of light-colored woods does not require bleaching. The strength of semichemical hardwood pulp is appreciably higher than that of hardwood sulfite pulp and approaches that of sulfate pulp made from the same wood.

Hardwood neutral sulfite semichemical pulp is used in a blend with softwood chemical pulp and softwood groundwood pulp in one newsprint mill in Canada. It is reported that the newsprint made from this furnish is acceptable but machine speeds are relatively low in this mill.

Cold-soda pulp--In the cold-soda pulping process recently developed at the Forest Products Laboratory, hardwood chips are soaked at room

temperature for about 2 hours in a relatively strong solution of caustic soda. The treated chips are then fiberized in an attrition mill. Variations of this procedure have included pressure treatment to shorten the soaking time and also treatment of the chips with caustic soda simultaneously with a primary mechanical treatment in a continuous process.

Hardwood cold-soda pulp contains more fibers of intermediate length and less fines than groundwood pulps, and makes a sheet that is stronger and of higher density. Yields of cold-soda pulp suitable for newsprint are in the range of 85 to 92 percent of the weight of wood used.

Southern newsprint producers have successfully used cold-soda pulp in pilot plant operations and are now in the process of starting commercial production of cold-soda pulp. It is contemplated that newsprint will be made using about 25 percent southern pine kraft pulp, 15 percent hardwood cold-soda pulp, and 60 percent southern pine groundwood pulp. This operation will thus parallel the production of a northern mill using 25 percent spruce-fir sulfite pulp, 25 percent hardwood chemigroundwood pulp, and 50 percent spruce-fir groundwood pulp.

Variable Yields Obtained from Semichemical Type Pulps

Although hardwood semichemical pulps have been used in newsprint furnish under a number of conditions, only at one mill has a furnish containing hardwoods been used on a commercial, large-scale, continuous basis in producing newsprint on modern high-speed paper machines. In that mill a furnish with 25 percent chemigroundwood pulp made from aspen and mixed northern hardwoods has been evolved through experience gained since 1954. In this case little

if any reduction of the expensive long-fiber chemical pulp has been achieved, and the hardwood fiber has been used essentially as a replacement for softwood groundwood fiber. Although production costs for this semichemical pulp are reported to be quite similar to costs for softwood groundwood pulp, use of hardwoods permits a more efficient wood procurement program.

In using hardwood semichemical pulps in newsprint, the pulping process has generally been such as to produce a high yield pulp, groundwood-like in quality, and approaching groundwood in cost. However, considerable effort also has been expended in developing semichemical pulps of lower yield but higher strength which, after bleaching, may replace a portion of the long-fibered pulp in the newsprint furnish. These processes may employ either cold-soda, neutral sulfite or kraft liquors. Use of these higher strength hardwood pulps on high-speed commercial machines has been limited.

Bleaching Requirements Depend on Species Used

Bleaching of pulps produced by the cold-soda, chemigroundwood, neutral sulfite semichemical, and groundwood processes ordinarily is not required for newsprint when light-colored woods such as aspen, cottonwood, paper birch, yellow-poplar, and tupelo are used. Pulps made from the darker woods like maple, ash, elm, hickory, and oak, if used in any appreciable proportion, no doubt would require some bleaching. This may be accomplished in a one-stage treatment using relatively small amounts of hypochlorite or peroxide. Higher brightness values can be obtained in multistage treatments including combinations of hypochlorite, peroxide, or hydrosulfite.

Aspen Groundwood Pulp also Suitable for Use in Newsprint

There is considerable evidence that a substantial amount of aspen groundwood may be used successfully in newsprint. Not only is considerable aspen groundwood used in magazine and book papers, but this pulp also has gained acceptance in several Canadian newsprint mills operating low-speed newsprint machines.

Groundwood pulps made from most hardwoods have very little strength and their use in newsprint is not considered feasible. However, aspen and other poplars do produce groundwood pulp of relatively high strength. Laboratory tests of aspen groundwood reveal its superiority in many respects to the southern pine groundwood which comprises about 75 percent of the newsprint furnish used in southern mills. Aspen groundwood is not only as strong as southern pine groundwood pulp but also imparts other desirable properties to newsprint.

Laboratory and Commercial Experience Indicate Varied Possibilities for Using Hardwoods in Newsprint

Many experiments at the Forest Products Laboratory and at other research and commercial establishments have shown that paper with strengths and other physical characteristics comparable to commercial newsprint can be made from a variety of hardwood and softwood pulp mixtures. Properties of newsprint made from various furnishes on a low-speed experimental paper machine are shown in table 10.

Hardwood pulps made by the neutral sulfite semichemical, cold-soda, or chemigroundwood processes have been used successfully in replacing a part of the softwood groundwood and a part of the chemical pulp normally used in newsprint furnishes, as illustrated by machine runs 4235, 4236,

4237, and 4244. Newsprint paper of good quality has also been made experimentally from 100 percent hardwood pulps in machine runs 4242, 4243, and 4250. However, these papers could not be made at commercial operating speeds because of the low tensile strengths of the wet sheet. The use of 25-30 percent long-fiber chemical pulp is considered essential for high speed operation.

Newsprint Furnish Containing Mainly Pulps from Northern Hardwoods Considered Feasible

It is concluded on the basis of research findings at the Forest Products Laboratory and other research institutions and industrial experience in commercial newsprint mills that a suitable furnish for the manufacture of newsprint that could be run at machine speeds of 2,000 feet per minute, could consist of approximately 60 percent aspen groundwood, 15 percent cold-soda pulp from mixed hardwoods, and 25 percent unbleached softwood sulfite or semibleached softwood sulfate pulp.

Results of experimental tests of this furnish are shown in table 11. Most properties of the experimental papers described therein are close to the averages for commercial newsprint. The paper from machine run No. 5304 was a little less dense than the average shown for commercial newsprint. It also had a little lower bursting strength but was higher in tearing strength. Its opacity was very close to the average for newsprint when allowance is made for the differences in brightness.

The denser paper made in machine run No. 5305 was comparable to the average for newsprint in bursting strength, and it was a little higher in tearing and in tensile strengths. Its opacity, however, was slightly lower than that of the bulkier paper. The

Table 10.--Properties of experimental newsprint papers containing various percentages of hardwood and softwood pulps

Machine run No.	Furnish		Bursting strength	Tearing strength	Tensile strength	Castor oil penetra- tion	Air resist- ance (Gurley)	Opacity	Bright- ness (G. E. equiva- lent)	Density
	Kind of pulp	Amount								
		Percent	Pts. per lb. per rm. ¹	Gm. per lb. per rm. ¹	Lb. per in. width	Sec.	Sec.	Percent	Percent	Gm. per cc.
--	Average 56 commercial news- print papers.....	--	0.25	0.54	8.4	50	52	92	58	0.64
1643	Aspen semichemical.....	25	.25	.52	5.4	66	48	90	56	.96
	Jack pine groundwood.....	75								
1724	Paper birch semichemical.....	50	.28	.58	10.2	43	60	88	52	.77
	Paper birch groundwood	30								
	Spruce groundwood.....	20								
3172	Aspen semichemical.....	25	.32	.53	12.7	80	69	89	61	.67
	Spruce groundwood.....	75								
4237	Cottonwood semichemical.....	30	.30	.89	10.0	47	58	86	67	.57
	Cottonwood groundwood.....	60								
	Southern pine bleached sulfate	10								
4242	Cottonwood semichemical.....	25	.25	.56	8.7	45	29	88	69	.53
	Cottonwood groundwood.....	75								
3507	Aspen bleached cold soda.....	50	.19	.54	7.3	67	55	88	61	.73
	Spruce groundwood.....	50								
4236	Cottonwood cold soda.....	30	.28	.85	10.1	50	36	87	64	.57
	Cottonwood groundwood.....	60								
	Southern pine bleached sulfate	10								
4243	Cottonwood cold soda.....	25	.21	.54	8.0	46	31	90	67	.54
	Cottonwood groundwood.....	75								
5305	Mixed hardwoods cold soda....	15	.23	.66	9.6	68	70	89	60	.65
	Aspen groundwood.....	60								
	Softwood sulfite.....	25								
3617	Sweetgum chemigroundwood ²	40	.24	.85	7.6	20	6	82	55	.67
	Southern pine groundwood.....	40								
	Southern pine bleached sulfate	20								
4035	Red alder chemigroundwood ³	40	.32	.56	12.1	59	68	88	60	.59
	Alpine fir groundwood.....	60								
4235	Cottonwood chemigroundwood ² ...	30	.25	.77	8.9	58	47	88	69	.60
	Cottonwood groundwood.....	60								
	Southern pine bleached sulfate	10								
4244	Cottonwood chemigroundwood ³ ...	30	.26	.82	9.4	41	25	86	66	.52
	Cottonwood groundwood.....	60								
	Southern pine bleached sulfate	10								
4250	Cottonwood chemigroundwood ³ ...	25	.22	.52	8.0	41	26	89	67	.52
	Cottonwood groundwood.....	75								

¹ Standard ream, 25 x 40--500. To convert to newsprint trade ream, 24 x 36-500, multiply by 1.157.² Mild treatment.³ Severe treatment.

Source: Forest Products Laboratory, Forest Service, U.S. Department of Agriculture.

Table 11.--Properties of newsprint paper containing pulps made from northern hardwoods

Property	Machine run ¹		Averages of commercial newsprint
	5304	5305	
Headbox freeness (Canadian Standard).....ml..	100	100
Sheet properties:			
Weight (per ream 25x40--500).....lb..	37.3	36.4	38.2
(per ream 24-36--500).....lb..	32.2	31.4	32.8
Thickness.....mils..	3.4	3.1	3.3
Density.....gm. per cc..	0.61	0.65	0.64
Bursting strength.....pts..	6.3	8.5	8.4
.....pts. per lb. per rm. ² ..	0.17	0.23	0.22
Average tearing resistance.....gm..	30.5	24.0	20.5
.....gm. per lb. per rm. ² ..	0.81	0.66	0.54
Average folding endurance (M.I.T.).dbl. folds..	5	6
Average tensile strength....lb. per in. width..	8.0	9.6	8.4
Castor-oil penetration.....sec..	69	68	50
Air resistance (Curley).....sec. per 100 cc..	60	70	52
Opacity.....percent..	90.9	88.8	92.6
Brightness (G. E. equivalent).....percent..	60.9	59.5	58.0

¹ Pulp furnish consisted of 60 percent aspen groundwood, 15 percent mixed hardwood bleached cold soda, and 25 percent commercial softwood sulfite pulp. For machine run 5305 the aspen groundwood was centricleaned.

² Ream size--500 sheets, 25 by 40 inches.

Source: Forest Products Laboratory, Forest Service, U.S. Department of Agriculture.

castor-oil penetration and air resistance tests used to measure printability were not objectionably higher than those of the standard.

Additional Commercial Testing Needed

As indicated above, considerable laboratory and commercial experi-

ence now available has demonstrated the technical feasibility of using hardwood pulps in newsprint furnish. Final determination of the machine speeds possible with various pulp mixtures using hardwoods, determination of production costs, and determination of printing performance of papers containing hardwoods will, however, require additional, large-scale, commercial trials.

The greatest difficulty encountered in using the shorter fibered hardwood pulps in paper making is that of developing sufficient wet and dry bonding strength for high-speed modern newsprint machines. The low drainage rates of water from hardwood fiber also may involve other problems. Mill improvements such as longer wire screens for increased drainage time, greater suction box capacity to remove more water, and either chemical or mechanical means to strengthen or assist in handling low-strength wet webs between machine sections thus may be necessary for a high level of efficiency in use of hardwood fibers in newsprint.

B. Other Pulp and Paper Products

In addition to newsprint, there are highly promising opportunities for expanded use of hardwood pulps in a wide variety of paper and board products, both in integrated mills in the Lake States and in plants in other regions which depend upon purchase of market pulp. Manufacturing technology is well established for use of hardwood pulps in many papers and paperboards, as well as in dissolving pulp for rayon and other cellulose derivatives.

Many Types of Paper and Board Produced in the Lake States

The paper products now produced in the Lake States are mostly of the cultural types such as book and magazine paper, writing paper, tissues, food containers, and special wrappings, although smaller amounts of industrial types such as shipping containers, building paper and board, heavy wrapping, and bag papers also are produced. Newsprint was at one

time one of the most important grades of paper made in the Lake States, but as a result of increasing wood costs, competition from modern newsprint mills, and other factors, all companies in the region eventually converted to the making of more profitable grades of papers, such as those described below.

Printing papers.--Printing papers other than newsprint, including magazine, book, tablet, and mimeograph papers, are often made with hardwood pulps produced by the soda, sulfite, groundwood, and semichemical processes as a part of the furnish. Bleached cold-soda pulp is now used in two U.S. mills producing white printing papers. Hardwood pulps are usually added to improve formation and surface smoothness, to serve as a filler, or to provide a base for subsequent coating.

Some book papers are now being made commercially from equal proportions of cold-soda hardwood pulp, and softwood groundwood and chemical pulp. Laboratory experience also indicates that acceptable book paper can be made using even higher percentages of cold-soda pulp.

Bond papers.--Bleached hardwood pulps prepared by both the sulfate process and the neutral sulfite semichemical process are also used successfully in the manufacture of bond paper. A fairly recent and highly satisfactory development in Wisconsin has been the use in bond papers of bleached sulfate pulp made from oak. Bleached semichemical pulps prepared from mixed hardwoods have also been highly satisfactory for this purpose.

Other papers.--Laboratory trials and commercial experience in using hardwood pulps for products as different as absorbent tissue and glassine have proved the versatility of hardwood pulps for specialty papers

of many kinds. Hardwood pulps may yield hard, dense sheets, on the one hand, or they can be made to produce bulky, absorbent, and soft products, depending upon the process chosen and the species of wood used.

Corrugating board and liner board.--Unbleached semichemical hardwood pulps are used to produce most of the corrugating board manufactured in the United States. Many hardwood species are used, often in mixtures. Hardwood pulp made by the cold-soda process has likewise been used recently in three mills in the United States to produce a good-quality corrugating board. It has also been found that addition of a small percentage of hardwood sulfate pulp to a softwood kraft liner board furnish will improve printability and surface texture; experience to date indicates that as much as 15 percent hardwood kraft pulp can be added without loss of strength.

Foodboards.--Both laboratory tests and commercial experience indicate that bleached hardwood pulps can be used for a fairly large percentage of the total furnish for foodboard. Hardwood pulps improve formation and surface texture and add desirable properties of stiffness, appearance and printability. These hardwood pulps can be made by the semichemical process, sulfate process, or the cold-soda process to give a considerable latitude in properties. Bleached neutral sulfite semichemical pulps produce boards with bursting strengths often as high as those of boards made of softwood pulps. Hardwood sulfate pulps produce sheets that are not quite as strong.

Foodboards have evolved from interesting specialties to high-tonnage standard products in a relatively short time, with increased use of milk and frozen food containers one of the principal factors in this record rise.

The expanding market for foodboards offer a particularly promising use for cold-soda and other hardwood pulps.

Structural fiberboard.--Woodpulp is used for all the hardboard manufactured in the United States and for about two-thirds of the fibrous raw materials used in insulation board. Pulps for both insulating board and hardboard can be prepared from either softwoods or hardwoods of both high and low density, such as aspen, mixed northern hardwoods, and sweetgum. The processes used involve steaming, grinding, semichemical cooking, attrition milling, defibrating, exploding, or the mechanical breakdown of raw wood. Since the density of insulating boards and hardboards depends on process details rather than on density of the wood used, hardwoods as well as softwoods are suitable for these products.

Opportunities for Increased Production of Hardwood Sulfate and Cold-soda Pulps

From a technical standpoint there are attractive possibilities in increased local manufacture of pulp from hardwoods--to reduce dependence on imported pulp, to substitute hardwood pulps for higher cost softwood pulps, and to meet expanding needs for woodpulp.

Hardwood sulfate pulp represents one of these possibilities and production costs for this product are therefore appraised at some length in Chapter IV. Sulfate pulp might be produced either for market pulp or for local use in integrated paper and board mills. Bleached hardwood sulfate pulp is being used in all segments of the paper industry, as well as for paperboards and for dissolving pulp. Many of the larger producers already sell this pulp product on the open market.

The production of cold-soda pulp at established plants offers another possibility for increased use of hardwoods and is therefore also appraised in Chapter IV. At the present stage of development of this process the best opportunities for cold-soda plants appear to be in conjunction with existing pulp and paper making facilities. This high-yield pulp loses much of its strength upon drying for shipment, and production as market pulp therefore does not seem feasible at this time. Cold-soda pulp can, however, be used effectively at the point of manufacture in a variety of papers and boards.

Pollution Control Required for New Plants in Lake States

The problem of stream pollution is an important consideration in the selection of pulping processes and location of new capacity for producing either newsprint or other grades of pulp, paper, or board.

In the States of Wisconsin, Minnesota, and Michigan regulations governing the pollution of streams by industrial waste generally require effective settling out of heavy solids, substantially complete removal of floating solids or liquids, and reduction of toxic materials to less than lethal limits for aquatic life, to the end that streams may be maintained or rendered suitable for appropriate uses.⁵

For mills located in Wisconsin approval of plans by the Wisconsin Committee on Water Pollution should be obtained in order to avoid difficulties that might arise from pollution. Recommendations of this Committee include mill design and operating practices that will insure reduction of effluent to a feasible minimum. Treatment of effluent will generally require

settling, filtration, or flotation by conventional methods, and construction of lagoons as insurance against discharge of suspended solids directly into streams.

For new mills established in Michigan it is necessary to obtain from the Michigan Water Resources Commission a permit to discharge effluents into State waters.

In Minnesota plans for the control of pollution by new mills must be reviewed and approved by the State Water Pollution Control Commission of the State Department of Health. Clearance and permits for use of State waters also are reviewed and acted upon by the Division of Waters, Department of Conservation. As is the case elsewhere, applications for specific locations are considered on their merits.

Pollution Varies Widely by Pulping Process

In the production of sulfate pulp the dilute wash water and other effluents ordinarily do not cause serious stream pollution troubles, though treatment may be necessary if the discharge is large in comparison with the volume and flow of the receiving stream. In this process spent liquor is evaporated and organic matter is burned, using the resultant heat for evaporating the spent liquor and for producing steam. The residual ash contains sodium and sulfur compounds which are recovered and used for making fresh cooking liquor.

Where neutral sulfite semichemical plants are operated in conjunction with sulfate pulp mills, the used liquor may under certain conditions be disposed of through the sulfate chemical recovery system, provided the tonnage of the neutral sulfite semichemical plant is not more than about one-fourth to one-third of the capacity of the sulfate mill with which it is

⁵ Wisconsin Administrative Code, Committee on Water Pollution, Chapter WP3, Interstate Joint Resolutions.

integrated. Otherwise it will ordinarily be necessary to treat liquor from neutral sulfite semichemical pulping before discharge into streams or install one of the recently developed methods of recovering sodium sulfite liquor.

The cold-soda and other semichemical type processes do not dissolve as much of the wood as the chemical processes, and both the inorganic chemicals and organic substances in the spent liquor are lower for a given amount of pulp. In the cold-soda and the chemigroundwood processes the cooking solutions are used repeatedly, and either bled off continuously or discarded when the accumulation of organic matter in the liquor begins to affect the color of the pulp.

Pulping by the sulfite process without liquor recovery involves serious pollution problems and partly because of this fact there has been relatively little expansion of sulfite capacity in recent years. Evaporating and burning calcium-base sulfite liquor is difficult to justify except in regions where fuel costs are high. However, many of the pollution difficulties encountered in treatment of sulfite liquor are overcome by using more soluble bases such as magnesium and sodium, together with suitable recovery processes.

The relative amount of pollution resulting from the effluent produced by different pulping processes may be indicated by the 5-day biochemical oxygen demand test (B.O.D.), which is a measure of the consumption of oxygen in a stream by a waste effluent. Although solids concentration and toxicity also are important in stream pollution, the dissolved oxygen content is of major importance to fish life and stream biology.

Approximate biochemical oxygen demand (B.O.D.) values for various pulping processes, expressed in terms of pounds of oxygen per ton of

pulp produced, are shown in the following tabulation:

Process:	B.O.D.
Groundwood pulping	3-8
Sulfate pulping	55-70
Cold-soda pulping ⁶	50-100
Deinking plant wastes ⁶	⁷ 60-100
Semichemical neutral sulfite pulping ⁶	125-350
Sulfite pulping ⁶	500-600

These B.O.D. values are somewhat variable and approximate since pulp yields and amounts of effluent depend in part upon pulping methods and conditions at specific plants. Also, the rate at which a mill effluent reduces dissolved oxygen in a receiving stream depends on such factors as the temperature and the rate of volume flow of the stream. Thus with water at 52° F., a 5-day B.O.D. loading of 20 pounds per day will consume 1 part per million of dissolved oxygen at a flow rate of 1 cubic-foot per second. On the other hand, with a water temperature of 75° F., a loading of only 11 pounds per day will consume 1 part per million of dissolved oxygen at the same flow rate.⁸

Calculations of the minimum streamflow necessary to avoid pollution conditions critical for fish life are shown in table 12 for representative conditions in the Lake States. Thus a 500-ton newsprint mill depending partly on purchased pulp would require a minimum streamflow of 226 cubic feet per second. A 300-ton bleached hardwood sulfate mill would require a streamflow of 511 cubic feet per second, while a 100-ton bleached

⁶ Without recovery or treatment.

⁷ Per ton of wastepaper processed.

⁸ Determination of Stream Purification Capacity, by B. F. Lueck, A. J. Wiley, Ralph Scott, and T. F. Wisniewski, *Sewage and Industrial Wastes* 29: 1054-1065 (September 1957).

cold-soda mill would need a streamflow of 209 cubic feet per second.

Mill Sites Available in the Lake States Region

In the Lake States region minimum streamflows considerably exceeding the values shown in table 12 are available at a number of suitable mill locations. Thus on the Chippewa River in Wisconsin streamflows exceeding 1,000 cubic feet per second 95 percent of the time are shown for various gaging stations. Three gaging stations on the Flambeau River show flows exceeding 500 cubic feet per second 95 percent of the time. The Wisconsin

River at Merrill shows a flow exceeding 1,000 cubic feet per second 95 percent of the time.

For new mills in Michigan, it is believed that if the recommendations regarding pollution cited earlier for new mills in Wisconsin are followed, possibly with some modifications for certain locations, new pulp and paper mills could be established at a number of sites on lakeshores and on some of the larger rivers.

In Minnesota it is also believed that if the recommendations cited for Wisconsin are followed, satisfactory pulp and paper mill sites can be found on the Mississippi River, on the Lake Superior shore, and possibly on some of the other larger rivers.

Table 12.--Estimated minimum streamflow requirements for selected sizes of pulp and paper mills

Type of mill	Daily mill capacity	5-day B.O.D. of effluent		Dissolved oxygen consumed per day at 75° F. and streamflow rate of 1 c.f.s. ¹	Minimum streamflow needed to support fish life at 75° F. ²
		Per ton air-dry	Per day		
	<u>Tons air-dry</u>	<u>Pounds</u>	<u>Pounds</u>	<u>P.p.m.</u>	<u>C.f.s.</u>
Groundwood (aspen).....	300	6	1,800	164	41
Unbleached cold soda (mixed hardwoods).....	75	75	5,625	511	128
Bleached cold soda (mixed hardwoods).....	100	90	9,000	818	209
Bleached sulfate (mixed hardwoods).....	300	³ 75	22,500	2,045	511
Newsprint paper.....	500	5	2,500	227	57
Newsprint pulp & paper ⁴	500	86	9,925	902	226

¹ At 75° F. and a streamflow rate of 1 c.f.s., approximately 11 pounds of B.O.D. will consume 1 part per million of dissolved oxygen.

² Assuming an original dissolved oxygen content of 7 parts per million and a minimum allowable dissolved oxygen content of 3 p.p.m.

³ Total of maximum values, including debarking, pulping, and bleaching, as reported by State Water Pollution Control Board, Sacramento, California. Waste Treatment and Disposal Aspects to Development of California's Pulp and Paper Resources, Publication No. 17, 1957.

⁴ Assuming use of 300 tons aspen groundwood, 75 tons cold soda, and 125 tons of purchased bleached softwood chemical pulp.

Source: Forest Products Laboratory, Forest Service, U.S. Department of Agriculture.

CHAPTER III

PULPWOOD SUPPLIES AND COSTS IN THE LAKE STATES

This chapter presents a summary of the available information on timber resources in the Lake States region, some indication of the future outlook for wood supplies, and the estimated costs of wood which new plants or an expanding industry might be expected to pay for pulpwood. Detailed information on wood supplies is available in various Forest Survey reports; this chapter presents only some highlights of these resource statistics.

One of the important factors tending to limit expansion of pulp and paper production in the Lake States region has been a tight supply situation for the softwood pulpwood which the industry in that area has largely been geared to use. Growth of the industry in this region in recent years has therefore been based to a large extent on aspen and other hardwoods. With the rising cut of aspen, available

supplies of this species also have become rather fully utilized in some areas. The question of local wood supply is thus of major importance in judging the feasibility of producing newsprint or expanding production of other pulp and paper products.

Lake States Forests Are Primarily Hardwoods

There are approximately 52.6 million acres of commercial forest land in the Lake States region as shown in table 13. On roughly three-fifths of this area hardwood types predominate--including about 15 million acres of aspen and 17 million acres of other hardwoods such as oak, maple, and elm. Pine types, including jack pine, red pine and white pine, occupy about 4 million acres. Other softwood types, including mainly spruce, fir, hemlock

Table 13.--Forest type areas in the Lake States

(Million acres)

State	Total	Aspen	Other hardwoods	Pine	Other softwoods	Non-stocked
Wisconsin.....	15.4	4.6	6.2	1.0	1.0	2.6
Minnesota.....	18.1	6.0	3.2	1.3	3.1	4.5
Michigan.....	19.1	4.8	7.4	1.6	2.2	3.1
Lake States....	52.6	15.4	16.8	3.9	6.3	10.2

Source: Forest Service, U.S. Department of Agriculture.

and cedar, total about 6 million acres, as shown in table 13.

All these types are typically found in mixtures throughout each of the three Lake States. The aspen and pine types are rather equally scattered among the three States. Approximately half of the area in other softwoods is found in Minnesota, however, while other hardwoods are somewhat concentrated in Michigan and Wisconsin.

The present-day forests in the Lake States consist for the most part of young stands of small-size trees. These forests are still in a state of recovery following heavy cutting of the original timber and subsequent repeated burning of the land. Although stocking is steadily increasing as a result of fire protection and planting, most stands are still below optimum stocking and some areas, particularly the hardwood types, contain a high

proportion of low-value and defective trees. Approximately 20 percent of the total forest area, or 10.2 million acres, is nonstocked; much of this land will require planting to restore productive forests.

Most of the commercial forest lands in the Lake States are concentrated in the northern part of the region, as shown in table 14. The northern survey districts--the boundaries of which are shown in figure 7--contain 82 percent of the forest land. They also include 97 percent of the softwood growing stock volume, and 80 percent of the hardwood pulp timber volume.

Hardwood Pulpwood Makes Up Increasing Portion of Pulp Mill Receipts

For many years the Lake States pulp industry depended primarily on softwood pulpwood. In recent years, however, use of hardwoods has been

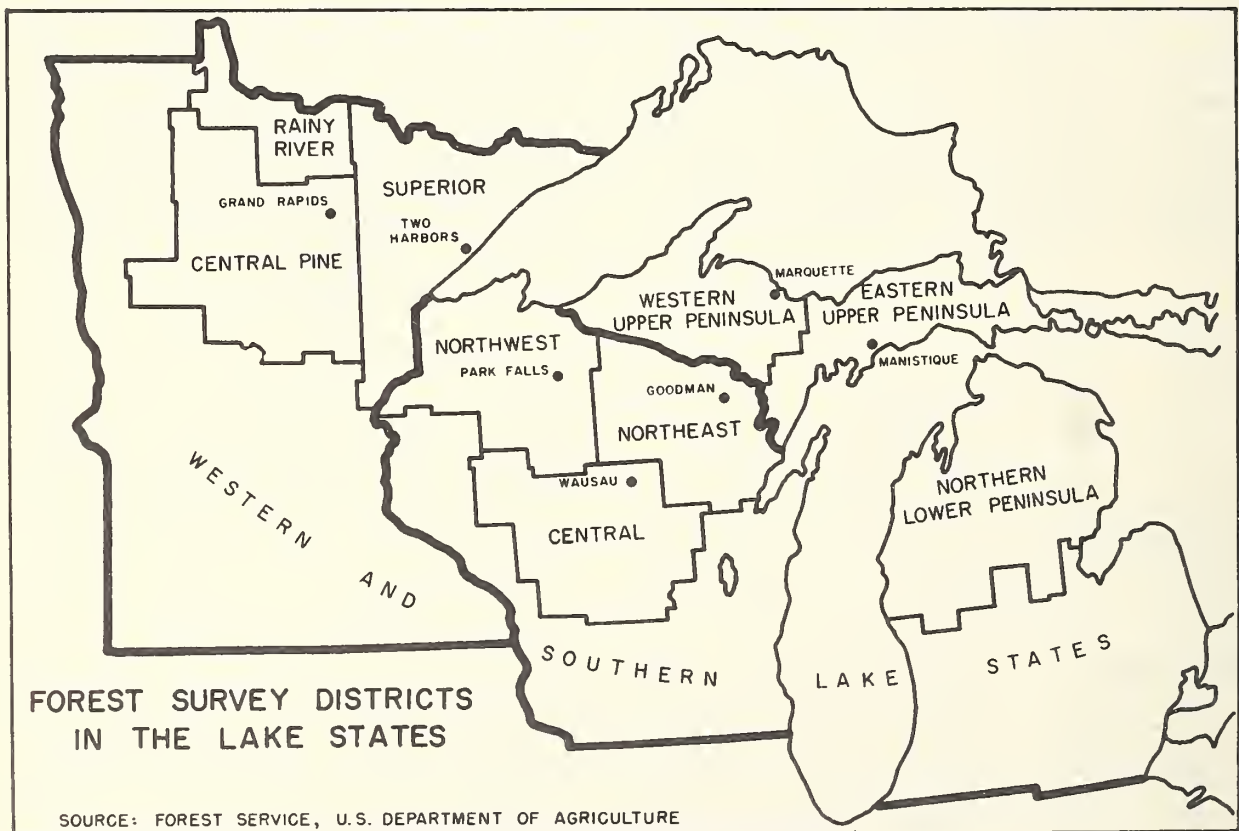


FIGURE 7

Table 14.--Forest areas and timber volumes in the Lake States, by districts

State and survey district	Commercial forest land area	Growing stock volume ^{1/}	
		Softwoods	Hardwoods
	<u>Thousand acres</u>	<u>Thousand cords</u>	<u>Thousand cords</u>
Wisconsin:			
Northeast.....	4,157	8,913	15,131
Northwest.....	5,197	5,313	17,885
Central.....	2,875	2,174	7,491
Southeast.....	941	712	3,091
Southwest.....	2,226	546	8,850
Total.....	15,396	17,658	52,448
Michigan:			
E. Upper Peninsula.....	4,291	13,197	11,719
W. Upper Peninsula.....	4,748	11,171	16,012
N. Lower Peninsula.....	7,508	7,547	25,272
S. Lower Peninsula.....	2,574	507	9,688
Total.....	19,121	32,422	62,691
Minnesota:			
Superior.....	5,991	16,353	12,580
Central Pine.....	6,358	11,190	14,872
Rainy River.....	2,077	6,671	2,805
Southeast.....	2,166	500	6,434
Western.....	1,506	650	3,022
Total.....	18,098	35,364	39,713
Total Lake States.....	52,615	85,444	154,852

^{1/} Includes all softwood and aspen trees above 5 inches diameter at breast height but only trees 5.0-10.9 inches in diameter of other hardwood species.

Source: Forest Service, U. S. Department of Agriculture.

increasing rapidly, as shown in table 15. In 1957, for example, aspen made up 37 percent of all pulpwood receipts at Lake States mills and other hardwoods 7 percent.

Receipts of aspen pulpwood, for example, increased from 741,000 cords in 1950 to about 1.3 million

cords in 1957--an increase of 75 percent. Use of other hardwoods during this same period more than quadrupled, rising from 60,000 to 278,000 cords per year. At the same time use of softwood pulpwood rose moderately from 1.6 million cords in 1950 to about 2 million cords in 1957.

Table 15.--Pulpwood receipts at Lake States mills, by species, 1945-57

(Thousand cords)

Year	All species	Spruce and fir	Pine	Other softwoods	Aspen	Other hardwoods
1945.....	2,517	1,093	527	317	548	32
1946.....	2,918	1,299	559	338	690	32
1947.....	2,664	1,265	593	228	554	24
1948.....	2,951	1,422	625	194	674	36
1949.....	2,102	1,042	390	114	516	40
1950.....	2,419	989	487	142	741	60
1951.....	3,503	1,374	803	240	991	95
1952.....	3,228	1,457	600	205	894	72
1953.....	2,802	1,059	523	129	986	105
1954.....	3,018	1,210	497	137	1,053	121
1955.....	2,955	1,058	517	106	1,127	147
1956.....	3,506	1,037	633	162	1,441	233
1957.....	3,532	1,288	530	142	1,294	278

Source: Forest Service, U. S. Department of Agriculture.

The increase in use of hardwoods was especially marked in Wisconsin. In that State receipts of aspen pulpwood increased 90 percent between 1950 and 1957--from 387,000 cords in 1950 to 739,000 cords in 1957. Receipts of mixed hardwoods rose from 21,000 cords in 1950 to about 220,000 cords in 1957.

This changing use of pulpwood is indicative of the local pressures on Lake States pulp mills to use more of the locally abundant and lower cost hardwoods. It also directly reflects new technology in pulping that permits

efficient use of hardwoods in many grades of paper and board, as pointed out in Chapter II.

Pulpwood Use Concentrated in Wisconsin But Wood Obtained Mainly From Out of State

Of the 51 pulp mills located in the Lake States region, 29 are located in the State of Wisconsin, chiefly along the Wisconsin and Fox-Wolf River systems. These mills have about half of the pulping capacity in the Lake States, as shown by the following tabulation.

State:	Number of pulp mills	Capacity (tons per day)	Percent of total capacity
Wisconsin.	29	4,155	52
Minnesota.	9	1,925	24
Michigan..	13	1,915	24
Total....	51	7,995	100

An even larger proportion of pulpwood consumption is located in Wisconsin, as shown in table 16. Thus in 1957 Wisconsin mills consumed about 64 percent of the 3.5 million cords of wood used in the Lake States. Wisconsin pulpwood producers, however, accounted for only 26 percent of total pulpwood used in the region. Minnesota, Michigan, and Canada, on the other hand, shipped substantial quantities of pulpwood to Wisconsin.

This general pattern of wood procurement in the Lake States region in 1957 is illustrated in figure 8.

The dependence of Wisconsin mills on wood obtained from out-of-state

is particularly pronounced in the case of softwoods, as shown in table 17. Considerable quantities of aspen also are obtained from out-of-state sources. Thus 95 percent of the spruce pulpwood used in Wisconsin was obtained from out-of-state, compared with 41 percent for aspen and 10 percent for other hardwoods. Shipments of fir and pine pulpwood from other States also substantially exceeded the amount of wood produced within the State of Wisconsin. Mills in Minnesota and Michigan, on the other hand, obtained nearly all their wood requirements from within the home State.

Surplus Allowable Cut of Hardwoods Available in Most Parts of Region

The allowable cut of both aspen and other hardwoods is materially in excess of the actual cut in all parts of the Lake States except central

Table 16.--Pulpwood production and consumption in the Lake States, 1957

State	Amount produced for Lake States mills		Amount consumed in Lake States	
	<u>Thousand cords</u>	<u>Percent of total</u>	<u>Thousand cords</u>	<u>Percent of total</u>
Wisconsin.....	1 928	26	2,247	64
Minnesota.....	1,049	30	753	21
Michigan.....	980	28	532	15
Canada and other United States.....	575	16	--	--
Total.....	3,532	100	3,532	100

¹ Wisconsin production 934,000 cords, but 6,000 cords were shipped out of the Lake States region.

Source: Forest Service, U.S. Department of Agriculture.

SOURCE OF PULPWOOD USED IN THE LAKE STATES, 1957

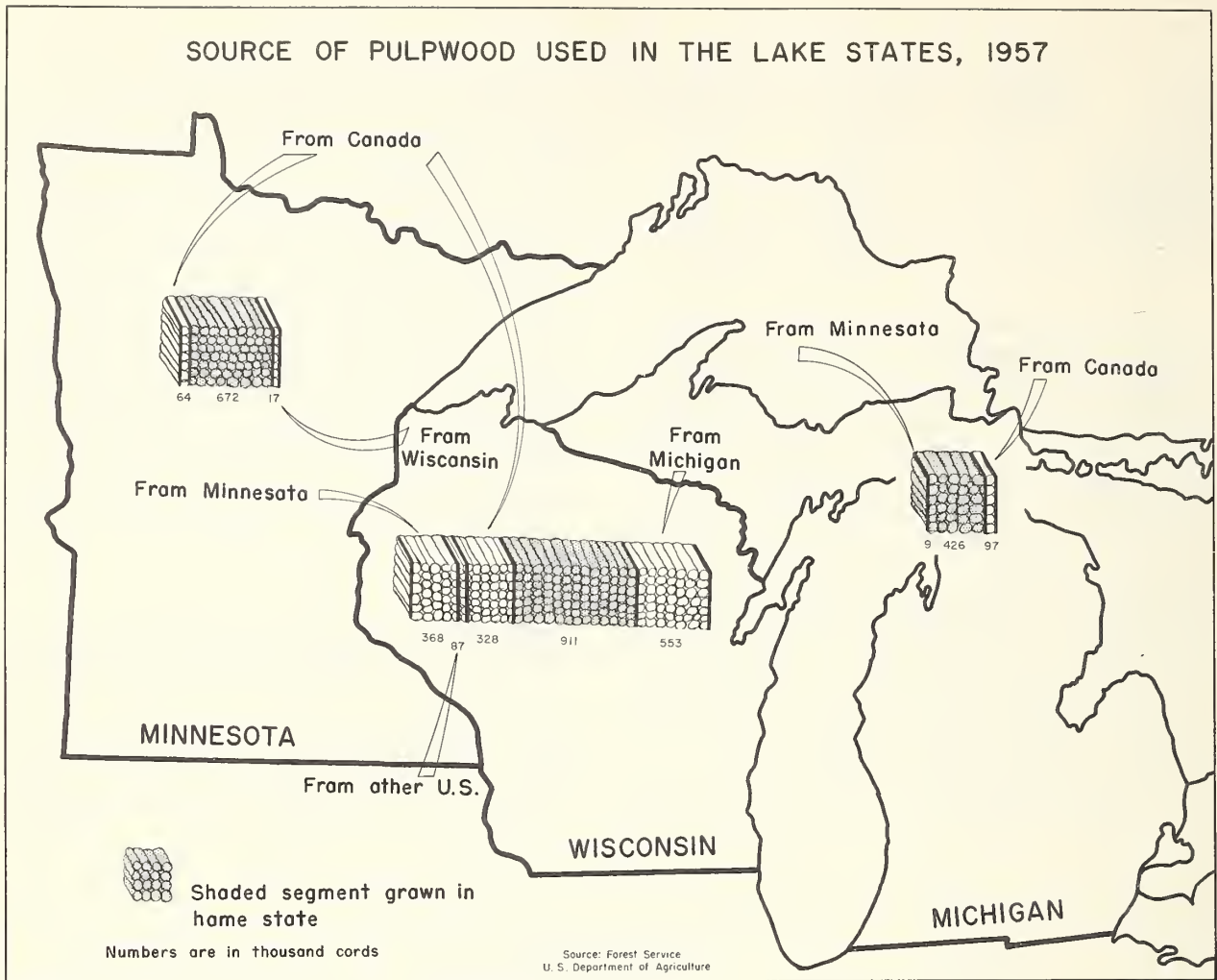


FIGURE 8

Wisconsin, as shown in table 18. Detailed figures on relationships between allowable cut, actual cut, and growth are shown by districts and species in appendix table 6.

For the northern Lake States as a whole (see fig. 7), the surplus allowable cut of aspen pulpwood amounts to nearly 900,000 cords per year. Most of this is in northern Minnesota and the northern part of lower Michigan, although substantial volumes also are present in the Upper Peninsula of Michigan. Practically all the northern districts also show a substantial surplus of mixed hardwoods, including oak, maple, elm, and various other species.

The western and southern Lake States area historically has not been considered a source of pulpwood for mills in the northern part of the region, mainly because of distance and the small size and scattered nature of the timber stands in this area. However, the western and southern districts have an annual surplus allowable cut of about 250,000 cords of aspen and other hardwoods and undoubtedly will be drawn upon to some extent as the consumption of hardwood pulpwood rises.

The estimates of allowable cut shown for the Lake States were calculated as the volume of timber that could be cut annually over a 10-year

Table 17.--Pulpwood receipts at Wisconsin mills by source and species, 1957
(Thousand cords)

Source	Species						
	Total	Aspen	Other hard- woods	Spruce	Fir	Pine	Other soft- woods
Wisconsin.....	911	437	200	28	59	124	63
Minnesota.....	368	16	2	140	97	105	8
Michigan.....	553	281	16	79	96	22	59
Other U.S.....	87	--	--	38	--	49	--
Canada.....	328	5	3	293	1	26	--
Total.....	2,247	739	221	578	253	326	130

Source: Forest Service, U.S. Department of Agriculture.

period while building up and improving forest capital. It was assumed that cutting would follow reasonably good forestry practices and would be done only on lands that would support a minimum cut of at least 3 cords per acre. This concept of allowable cut does not involve any legal restrictions but is rather a yardstick to indicate the desirable cut within an area during the immediate future. Cutting in excess of the allowable or desirable cut would not necessarily damage the stands but would add to the time necessary to build up the forest to a high level of productivity.

As growth and stand volumes build up the allowable cut automatically tends to rise. There is thus a conservative bias in the estimates of allowable cut shown in table 18 and appendix table 6. The calculations therein are based on inventories made over a period of years, and as a result of improvements in stand con-

ditions the current allowable cut may well be somewhat higher than that indicated.

Additional wood supplies also could be realized from light thinnings and stand improvement work in intensively managed stands, and use of cull trees and logging residues. None of these potential sources in the northern Lake States, nor any timber in the southern and western districts, were considered in the allowable cut calculations used in this report.

Net Surpluses of Softwoods Are Small

It is also evident from table 18 that allowable cut surpluses of softwoods currently available in the region are quite small. Northern Wisconsin is a deficit area for softwood pulpwood, with shortages of the principal pulping species--spruce, fir, and pine. Current surpluses of

allowable cut of these species in the Upper Peninsula of Michigan and northern Minnesota are about 200,000 cords a year. Fairly large quantities of other softwoods such as hemlock, larch, and cedar are available, but except for hemlock these are not currently used to any great extent for pulpwood production.

In the jack pine forests of the Superior District in Minnesota the

allowable cut of red and jack pine is roughly four times the current growth and a substantial expansion of cutting in this area is possible. Pulpwood production in this district has been limited by the high freight costs to established mills. It may be expected, however, that continued softwood deficits in other districts will tend to stimulate greater use of the pine timber in this area.

Table 18.--Estimated annual surplus or deficit(allowable cut minus actual cut) of growing stock in the northern Lake States, by species and survey districts

(Thousand cords)

District ¹	Aspen	Other hard-woods ²	Spruce	Balsam fir	Red & jack pine	Other soft-woods
Northern Wisconsin:						
Northeast.....	18	50	-1	-6	16	7
Northwest.....	92	73	2	7	-7	-13
Central.....	-41	-16	-1	-1	-53	-3
Total.....	69	107	0	0	-44	-9
Northern Michigan:						
Eastern Upper Peninsula....	98	124	33	29	55	130
Western Upper Peninsula....	12	41	-21	-27	8	-20
Northern Lower Peninsula...	220	171	10	20	42	54
Total.....	330	336	22	22	105	164
Northern Minnesota:						
Superior.....	159	80	66	50	115	50
Central Pine.....	317	102	2	19	-61	34
Rainy River.....	4	16	-41	-6	-2	10
Total.....	480	198	27	63	52	94
Total.....	879	641	49	85	113	249

¹ For map of districts, see figure 7.

² Poletimber trees only; excludes approximately 40 percent of total volume of other hardwoods in sawtimber-size trees.

Source: Forest Service, U.S. Department of Agriculture.

Timber Growth and Volumes Increasing

The present timber situation in the Lake States probably represents an intermediate point between the near devastation of some years ago and potential levels of timber production. Although growth has been increasing steadily as stands have thickened up, further improvements in stocking and in distribution of age classes may be anticipated.

Since forests in the Lake States are mainly young stands, in practically all areas the actual cut and the estimated allowable cut are less than the growth--in some cases substantially less, as shown in appendix table 6. These surpluses of growth point to some further increases in allowable pulpwood cut in the near future. This would be true for mixed hardwoods, although for aspen the long-term trend is not so clear. With continued efforts in tree planting and protection, and with improvements in cutting practices, an increased cut of softwoods also may be possible.

Recent projections of timber growth and growing stock in the Lake States, made on the assumption of a rising cut and continued improvements in forestry practices, indicate that within 2 or 3 decades timber volumes and growth for both hardwoods and softwoods may be significantly above present-day levels.

Pulpwood Timber Available for Increased Capacity

It may be concluded from these Forest Survey estimates that forest conditions and wood procurement possibilities are rather variable in the Lake States region, but that an expansion of pulp production could readily be based upon use of aspen and other hardwoods. A small surplus of allowable cut of softwoods, together with expectations of in-

creased future growth, also indicate that a small expansion in use of softwoods, of the general magnitude of requirements indicated in Chapter IV of this report, also is possible. If such expanded use of softwoods were to occur in northern Wisconsin, however, lengthy freight hauls from distant sources in Minnesota and perhaps the Upper Peninsula of Michigan would be necessary.

Timber Ownership Influences Availability of Pulpwood

A relevant consideration in connection with establishment of any new pulp and paper mill in the Lake States region is the prospective availability of land and timber, and the feasibility of additional wood procurement. Pulpwood supplies for any given mill generally are obtained from a number of producers who must compete for wood over fairly extensive wood procurement areas.

Ownership of commercial forest land and timber in the Lake States is widely dispersed in public and private holdings as shown in the following tabulation.

<u>Ownership:</u>	<u>Acres (thousands)</u>
National forest...	5,895
Other Federal....	1,645
State	7,747
County & municipal	6,152
Total public....	21,439
Forest industry..	3,039
Farm	14,828
Miscellaneous private.....	13,294
Total private..	31,161
All ownerships...	52,600

Federal holdings account for about 14 percent of the commercial forest

area, and State, county, and municipal lands approximately 27 percent of the total area. Farm ownerships represent 28 percent of the total, forest industry 6 percent, and miscellaneous private ownerships approximately 25 percent. There are roughly 492 thousand private owners of forest land in these three States.

The distribution of timber volumes by these owner classes is roughly similar to that for forest area. The county and State lands, however, in general bear somewhat younger age classes and lower volumes than do the private and national forest lands.

Ownership of pulpwood timber volumes by species in the northern Lake States is shown in table 19. Although conditions vary by districts, this table indicates that public holdings contain about 55 percent of the softwood timber and roughly 40 percent of the hardwood pulp timber.

In view of the wide dispersion of forest land holdings, the large number of private owners, and the general practice of selling public timber to the highest bidders, it seems likely that the pulpwood procurement procedures and conditions for a new pulp mill, or for new plant capacity, would not be greatly different from those which have prevailed in recent years for the existing industry.

Canadian Wood Important to Lake States Mills

Imports of Canadian pulpwood have long been important to Lake States pulp mills. In 1957, for example, nearly 500,000 cords of softwood pulpwood was imported from Canada. This was chiefly spruce pulpwood with smaller amounts of pine, balsam fir, and aspen.

The softwood pulpwood supply situation in the Lake States region could become tighter if the Province of Ontario were to put into effect a policy, announced in 1947, of limit-

ing exports of pulpwood cut on Crown lands. This element of uncertainty of imports adds to the need for forestry measures to increase domestic growth of softwoods, and emphasizes the desirability of broadening the base of the pulp and paper industry to use larger proportions of the locally available hardwoods.

Competition From Other Wood-Using Industries Is Limited

At the present time pulpwood accounts for about 58 percent of all the softwood timber cut and about 28 percent of the hardwood timber cut in the Lake States. Spruce and fir are used almost entirely for pulpwood. Two-thirds of the jack pine cut is for this use. Some of the "other softwoods" cut also are used for pulpwood.

Nearly two-thirds of the aspen cut in the Lake States likewise is utilized for pulpwood. High-quality hardwoods are processed mainly into lumber and veneer, but some of the mixed hardwoods cut also are used for pulpwood and for chemical wood and mine timbers. Much hardwood of pulpwood size also is cut for fuelwood and fence posts for use on farms and in the smaller towns. However, these combined uses of hardwoods take only a small part of the current surplus of pole-timber-size hardwood material.

Future supplies and price trends for softwoods, and for pulpwood-size hardwoods, in the Lake States thus are likely to be determined primarily by competition within the pulp and paper industry, rather than by competition from other forest industries. This outlook appears likely in spite of the policies on the national forests and certain other large private holdings to grow quality sawtimber, and notwithstanding the general desirability of increased production of sawlog and veneer log material in the region, as assumed in the esti-

Table 19.--Timber volumes in the northern Lake States, by species, ownership, and State

(Million cords)

State and ownership	Total	Spruce	Balsam fir	Red and jack pine	Other soft-woods	Aspen	Other hard-woods ¹
Northern Minnesota:							
Public.....	45.2	6.8	4.1	9.3	5.6	13.3	6.1
Farm.....	7.2	.7	.4	1.1	.4	2.6	2.0
Other private.....	12.1	1.4	.9	1.8	1.7	4.3	2.0
All owners.....	64.5	8.9	5.4	12.2	7.7	20.2	10.1
Northern Wisconsin:							
Public.....	18.8	.4	.8	1.6	3.8	5.6	6.6
Farm.....	24.0	.3	.6	1.4	3.2	8.5	10.0
Large private.....	4.2	.1	.2	.3	.8	1.3	1.5
Small private.....	9.9	.2	.3	.7	1.7	3.2	3.8
All owners.....	56.9	1.0	1.9	4.0	9.5	18.6	21.9
Northern Michigan:							
Public.....	29.0	1.7	2.2	2.2	6.8	6.3	9.8
Farm.....	12.9	.3	.4	.7	1.4	3.8	6.3
Large private.....	14.6	1.5	1.7	1.1	3.2	2.0	5.1
Small private.....	28.4	.7	.9	1.8	5.4	8.8	10.8
All owners.....	84.9	4.2	5.2	5.8	16.8	20.9	32.0
Total:							
Public.....	93.0	8.9	7.1	13.1	16.2	25.2	22.5
Farm.....	44.1	1.3	1.4	3.2	5.0	14.9	18.3
Other private.....	69.2	3.9	4.0	5.7	12.8	19.6	23.2
All owners.....	206.3	14.1	12.5	22.0	34.0	59.7	64.0

¹ Includes volume of poletimber trees only.

Source: Forest Service, U.S. Department of Agriculture.

mates of allowable cut presented earlier.

Wood Costs in the Lake States Vary Widely by Species

Average prices paid for pulpwood f.o.b. rail cars, in the 1957-1958

logging season varied both by location and by species, as shown in table 20. These prices were for cords of rough wood (i.e., unpeeled) of 100-inch length and to a 4-inch top, and containing about 133 cubic feet. The figures are estimates based upon a combina-

Table 20.--Pulpwood prices in the Lake States, by species, 1957-58

(Dollars per rough cord, f.o.b. car)

Location	Aspen	Other hardwoods	Spruce	Balsam fir	Pine
Wisconsin.....	¹ 12.50	13.00	27.00	22.00	17.00
Upper Michigan.....	14.50	13.50	27.00	23.00	17.50
Lower Michigan.....	10.50	11.00	22.00	--	13.00
Minnesota.....	11.00	--	24.00	18.00	15.50

¹ Most aspen pulpwood cut in Wisconsin is trucked to mills at a delivered price averaging about \$14.00 a cord.

Source: Compiled by the Forest Service, U.S. Department of Agriculture, from data reported by a number of pulp mills.

tion of published prices and reports from producers and buyers weighted by judgment as to the volume of wood handled at each price. They also include dealer's commissions where paid.

The level of pulpwood prices in 1957-58 in the Lake States was not greatly different from prices which have prevailed over the past several years, although they are considerably higher than prices prevailing before 1952. This movement of prices of rough pulpwood in the Lake States in recent years may be illustrated by the price trends for aspen pulpwood shown in table 21.

One of the reasons for the level of prices quoted for aspen and mixed hardwoods is the relative abundance and resulting low stumpage values that prevail for these species at present. Thus in Wisconsin the Conservation Commission, in connection with severance tax calculations, has been using a stumpage value of \$1.20 for

Table 21.--Prices of aspen pulpwood in Wisconsin, 1940-57

(Dollars per rough cord, f.o.b. car)

Year	Price	Year	Price
1940.....	4.25	1949.....	9.25
1941.....	4.75	1950.....	9.50
1942.....	6.90	1951.....	10.50
1943.....	8.75	1952.....	12.25
1944.....	9.00	1953.....	12.00
1945.....	9.60	1954.....	12.50
1946.....	10.00	1955.....	11.50
1947.....	11.50	1956.....	13.50
1948.....	12.00	1957.....	11.50

Source: Wisconsin Forest Products Price Review. Extension Service, University of Wisconsin. Compiled from data reported by a number of pulp mills.

mixed hardwoods and \$1.80 for aspen. Prices for softwood pulpwood in the Lake States, on the other hand, are substantially higher, as illustrated by stumpage prices received for sales of national-forest pulpwood timber. In F. Y. 1958, these averaged \$5.75 per cord for spruce, \$2.55 for jack pine, and \$3.75 for eastern hemlock.

In addition to prices paid to producers, such as those shown in the tables above, some additional costs are incurred by mills in the procurement of pulpwood. These include salaries and expenses--wood procurement and forestry personnel, for example, costs of operating wood concentration yards at rail loading points, extra costs of company logging operations on company lands, demurrage on rail cars, aid to pulpwood producers, and operation of mill woodyards. For the purpose of this study such costs have been included in mill operating costs.

Purchase of peeled rather than rough wood also may affect the stated costs of wood procurement. Most of all, the cost of transporting wood by truck, rail, or water is important.

Wood Transportation Costs Vary Widely

Producers delivering wood to Lake States mills by truck are generally paid \$1.00 to \$1.50 more per cord than the prices shown in the earlier tabulation for wood delivered f.o.b. cars.

In determining rail freight costs per cord, wood is scaled in cords on the cars and the cord scale then converted to pounds by application of "agreed" weights per cord established by the railroads and the pulp companies. Rates per 100 pounds are then applied to these standard weights. Sample weights, in pounds per cord of rough pulpwood, are shown below for three broad areas of origin:

Origin of wood:	Aspen	Pine	Balsam fir	Spruce
Minnesota	4100	4300	4400	4100
Wisconsin & Upper Michigan	4100	4400	4700	4300
Lower Michigan ...	4000	4100	4700	4400

Rail freight charges vary rather widely by loading points and in a general way by distance from loading points to mill. These may be illustrated by sample freight costs for rough pulpwood from points in Wisconsin, Upper Michigan, and northern Minnesota to the vicinity of Wausau, Wisconsin, as shown in table 22.

Estimated Wood Costs f.o.b. Mill

It is evident from this analysis of the location of pulpwood supplies and consumption in the Lake States that any significant amount of softwood pulpwood for a new mill or for expanded plant capacity in northern Wisconsin, for example, would have to be brought from some distance and would entail substantial transportation costs. Supplies of hardwood pulpwood, on the other hand, could largely be acquired from nearby areas with consequently lower costs of delivered wood.

It is possible that addition of new plant capacity for production of newsprint or hardwood pulps, such as projects appraised in Chapter IV, would tend to result in some general increases in pulpwood prices in the Lake States region. For the purpose of this study, however, wood costs approximating those prevailing in 1958 have been assumed.

Such estimated wood costs for new plant capacity located in northern Wisconsin are shown in table 23. These assume that the aspen required would be obtained from sources in all three States, other hardwoods from northern Wisconsin, and softwoods principally from Minnesota.

For mill sites in other areas wood costs f.o.b. mill will of course vary

Table 22.--Rail freight costs for pulpwood from sample locations in the Lake States to Wausau, Wisconsin, 1958

Origin	Approx. miles to Wausau	Rate per 100 lbs. (dollars)	Cost per cord of roughwood in dollars			
			Pine	Balsam fir	Spruce	Aspen
Wisconsin:						
Woodruff.....	70	.105	4.62	4.94	4.52	4.31
Hiles.....	80	.11	4.84	5.17	4.73	4.51
Newald.....	80	.13	5.72	6.11	5.59	5.33
Park Falls.....	100	.16	7.04	7.52	6.88	6.56
Goodman.....	110	.12	5.28	5.64	5.16	4.92
Bayfield.....	170	.15	6.60	7.05	6.45	6.15
Solon Springs.....	200	.13	5.72	6.11	5.59	5.33
Michigan:						
Iron Mountain.....	120	.15	6.60	7.05	6.45	6.15
Escanaba.....	180	.12	5.28	5.64	5.16	4.92
Rock.....	180	.15	6.60	7.05	6.45	6.15
Covington.....	200	.19	8.36	8.93	8.17	7.79
Marquette.....	210	.275	12.10	12.92	11.82	11.28
Manistique.....	220	.195	8.58	9.16	8.38	8.00
Newberry.....	280	.21	9.24	9.87	9.03	8.61
Trout Lake.....	300	.19	8.36	8.93	8.17	7.79
Minnesota:						
Askov.....	230	.225	9.68	9.90	9.23	9.23
Two Harbors.....	260	.215	9.25	9.46	8.82	8.82
Grand Rapids.....	320	.25	10.75	11.00	10.25	10.25
Forest Center.....	330	.25	10.75	11.00	10.25	10.25
Ely.....	330	.28	12.04	12.32	11.48	11.48
Bemidji.....	390	.285	12.26	12.54	11.69	11.69
Warroad.....	460	.38	16.34	16.72	15.58	15.58

Source: Compiled by the Forest Service, U.S. Department of Agriculture from data supplied by local railroads and the Interstate Commerce Commission.

depending upon location in relation to wood supplies. Thus it might be expected that costs of pine pulpwood delivered to mills in Minnesota would be lower than those shown for Wisconsin by as much as perhaps \$3.00 to \$6.00 per cord. Wood costs for aspen and other hardwoods delivered to mills located in Minnesota or Lower Michigan likewise might be lower

than the costs shown above for northern Wisconsin by perhaps \$1.00 to \$2.00 per cord. Such variations in costs may be of significant importance for specific plant location studies.

Hardwood Shows Low Costs Per Ton of Wood Fiber

The wood costs cited above have been shown in terms of standard cords

in accordance with usual measurement practices in the region. From the standpoint of pulp yields and costs per ton of pulp, price relationships

among species differ rather appreciably from those indicated above. Thus costs per ton of dry wood substance vary as shown in table 24.

Table 23.--Estimated average pulpwood costs for new mill capacity located in northern Wisconsin, 1958

(Dollars per rough cord)

Species	Source	Price f.o.b. cars	Average transportation	Cost f.o.b. mill
Aspen.....	N. Wisconsin.....	13.50	3.50	17.00
Aspen.....	U. P. Michigan.....	14.50	6.00	20.50
Aspen.....	Minnesota.....	11.00	11.00	22.00
Other hardwoods.....	N. Wisconsin.....	13.00	3.50	16.50
Pine.....	Minnesota.....	15.50	11.00	26.50
Spruce and fir.....	Minnesota.....	21.00	11.00	32.00

Source: Forest Service, U.S. Department of Agriculture.

Table 24.--Pulpwood costs in terms of dry wood substance, in the Lake States by species

Species	Dry wood substance per cu. ft.	Dry wood substance per cord		Cost f.o.b. mill	
				Per cord	Per ton
	<u>Pounds</u>	<u>Pounds</u>	<u>Tons</u>	<u>Dollars</u>	<u>Dollars</u>
Aspen.....	23	1,910	0.955	17.00	17.80
Mixed hardwoods....	35	2,905	1.453	16.50	11.40
Jack pine.....	24	1,990	.995	26.50	26.60
Spruce.....	25	2,075	1.038	34.00	32.80
Fir.....	21	1,745	.873	29.00	33.20

Source: Forest Service, U. S. Department of Agriculture.

This table clearly shows the cost advantage for hardwood pulpwood when considering the dry wood substance purchased. Costs of mixed hardwood pulpwood, for example, amounts to only \$11.40 per ton of wood substance, compared to \$17.80 for aspen and \$26.60 for jack pine. Wood costs for spruce and fir per ton of wood substance are substantially higher.

If pulpwood procurement practices in the Lake States should change so that wood is purchased on a weight basis, as is now the case in many other areas, these cost relationships among species might be changed. For the purpose of this study, however, it has seemed desirable to assume wood costs that reflect current procurement practices and competitive conditions now existing within the Lake States pulp and paper industry. The costs indicated in table 23 above have therefore been used in the cost analyses shown in Chapter IV.

Timber Supply Conditions in Other Regions an Important Competitive Factor

In appraising the economic feasibility of producing newsprint, other grades of paper and board, or wood-pulp in any particular area such as the Lake States region, an important additional consideration is the prospective availability of timber and the costs of producing pulp and paper products in other parts of the United States or Canada.

In recent years the pulp and paper industry has expanded in all regions of the United States and Canada, although expansion has proceeded at a somewhat greater pace in the Southern States. Additional expansion in the South undoubtedly is to be expected in view of the favorable factors of timber supply, production costs, and market location that characterize that region. Softwood timber resources in the West and hardwood timber throughout the

eastern States also could support additional production of pulp and paper products.

From the standpoint of timber supplies, Canada also has large potentials for increased output of pulp and paper products, particularly newsprint. According to the Royal Commission on Canadian Economic Prospects,⁸ the outlook for Canada may be indicated by the following quotation:

...It would appear that Canada possesses sufficient forest resources to support the increase in demand for wood which this country is likely to experience over the next quarter century. Without exception, the allowable cut estimated for each region has been shown to be well above the total drain inclusive of the commercial cutting operations and the fire, insect and disease losses forecast for 1980. These broad statements, however, require qualification. It is not at all certain that the requisite volume of wood will be available at a cost which will permit it to be sold in competition with other materials and with the products of the forest industries of other countries. Much depends upon the success of efforts devoted to reducing fire, insect and disease losses and the ingenuity with which management tackles the problem of increasing yields and reducing logging, transportation and processing costs. (p. 232.)

In discussing recent changes in competitive conditions the same report states:

These developments do not mean that Canada's advantage in pulp and paper manufacture has been lost but that it has narrowed. We have seen this in the expansion of the southern United States newsprint

⁸Royal Commission on Canada's Economic Prospects. The Outlook for the Canadian Forest Industries, March 1957.

industry...it has come about through improvements in technology...Now it is true...that this expansion in the South has been associated with a rapidly growing regional market; thus the advantage is, in a sense, temporary. The typical industrial pattern which follows the opening of a new resource region may be expected: rapid expansion to the point where rising resource and production costs make further growth unattractive. Clearly, however, this cost margin is relative; it will be determined by the cost-price relationships which prevail.

This is only another way of saying that expansion will occur where the investment required is econom-

ically attractive. On the assumption which has been made--namely, that pulp and paper costs need not rise relatively--it is expected that prospective world pulp and paper demand trends will be as indicated and that the Canadian industry, in turn, will share in these demands to the extent that somewhat more than a doubling of output is in prospect. (p. 144.)

Detailed appraisals of the relative economics of producing pulp and paper products in various regions and areas are of course not available. Accurate judgments on the relative feasibility of production in different parts of the United States and Canada must necessarily depend upon comparative economic and engineering studies.

CHAPTER IV

ECONOMIC ANALYSIS OF SELECTED PAPER INDUSTRY PROJECTS IN WISCONSIN

The following chapter consists of a report on prospective operating costs and capital investments required for production of newsprint, hardwood sulfate (kraft) market pulp, and cold-soda hardwood pulp at an assumed site in northern Wisconsin. The report was prepared by Ebasco Services, Incorporated, of New York City, a major engineering and consulting firm.

I - INTRODUCTION

The paper industry projects analyzed in this report are described as follows:

- 1) A facility to produce 500 daily tons of standard newsprint, complete with its integrated 350-TPD capacity aspen groundwood mill, 100-TPD capacity hardwood cold soda mill, and high-pressure steam power station, but dependent upon the open market for its supply of long-fiber pulp (semibleached kraft, or unbleached sulfite softwood).

The newsprint would be produced on wide, high-speed modern machines, the efficiencies of which are well proven in commercial experience. Several machines are now running successfully at speeds well in excess of 2000 FPM. Two such machines, each capable of a trimmed width of approximately 210 inches, have the potential capacity to produce 500 tons of daily production.

- 2) A similar facility to produce 500 daily tons of newsprint, complete with its integrated 350-TPD capacity groundwood mill, 100-TPD capacity hardwood cold soda mill, steam power station, and kraft pulp mill of 300 daily tons capacity. The kraft mill is to process both softwoods and hardwoods; 135 tons per day of softwood kraft pulp are to be utilized in making newsprint, and 165 tons per day of hardwood kraft pulp are to be bleached, dried, and baled for market sale.
- 3) A kraft pulp mill to produce 300 daily tons of fully bleached hardwood pulp for market sale, complete with chemical recovery facilities and steam power station.

- 4) A cold soda hardwood pulp mill for integration with an assumed existing paper mill, and capable of 100 tons of production daily, complete with wood handling, liquor making bleaching, and pulp washing facilities, but dependent upon assumed existing facilities for steam and power.

For purposes of analysis, it is assumed that this plant's product replaces an equal tonnage of market pulp currently purchased by the paper mill. Further, the Wisconsin mill undertaking this investment may well be assumed to make a groundwood book or publication paper, and would logically expect to replace a portion of long-fiber furnish as well as some groundwood. Hence a "replaced pulp" value of \$ 115.00/ton, between market bleached groundwood cost (\$ 100) and market unbleached sulfite cost (\$ 135) is used here.

The alternative assumption of increased paper production, through the additional pulp capacity provided, is ignored here due to the difficulty of predicting the economics without a specific set of facts. This alternative could be more realistic and attractive in some circumstances.

II - CONCLUSIONS

A - NEWSPRINT

The plant purchasing its softwood kraft does not cover interest requirements.

Pro forma income statements covering the first 5 years of plant operation at full nominal capacity in the plant manufacturing its own kraft pulp indicate a profit amounting to 6.9% of net worth. This compares unfavorably with the 1957 average (10.5%) of 10 large newsprint manufacturers. Such a return would not be attractive to venture capital.

Considerable pulpwood from outside the Northern Wisconsin-Upper Michigan area would be required to supply the plant.

COMPARISON OF EARNINGS NEWSPRINT MANUFACTURE		
	Average 10 Manufacturers 1957 (\$ 1,000)	Wisconsin Mill (\$ 1,000)
Net Worth	134,133	57,361
Total Investment	154,245	94,029
Net Profit	14,083	3,958
Profit Worth	10.5%	6.9%
Profit Investment	9.1%	4.2%

B - KRAFT MARKET PULP

Pro forma income statements covering the first 5 years of plant operation at full nominal capacity indicate a profit amounting to 11.6% of net worth. This compares favorably with the 1957 average of five pulp and lumber producers (7.0%). Such a return might be attractive to investors.

Some of the pulpwood supply for the mill would have to be procured from outside the Northern Wisconsin-Upper Michigan area.

COMPARISON OF EARNINGS PULP MANUFACTURE					
	Net Worth (\$ 1,000)	Total Invest- ment (\$ 1,000)	Net Profit (\$ 1,000)	Profit	
				Worth	Invest- ment
Average; 5 Pulp and Lumber Mfrs; 1957	67,118	99,284	4,686	7.0%	4.7%
Wisconsin Pulp Mill	27,790	43,623	3,213	11.6%	7.3%

C - COLD SODA PULP

A paper producer dependent to the extent assumed in this study upon pulp purchases in the open market, can expect a return of 10.2% profit on his total investment in a 100-TPD cold soda pulp mill. Since the capital amount is of moderate size, the parent organization would be likely to have several alternative paths of investment. These alternatives must be compared, technically as well as financially, in order to draw a specific conclusion on the project. However, the return is of an interesting magnitude.

This pulp mill operation would be able to obtain all its hardwood pulp-wood requirements in Northern Wisconsin.

III - PULPWOOD SUPPLY

A tabulation of supply-demand statistics, including delivered costs, is presented below. All data on supply of pulpwood has been furnished to Ebasco by the U. S. Forest Service.

All softwood is assumed to come from Minnesota, inasmuch as the supply available to a new producer in Northern Wisconsin and Upper Michigan is uncertain.

Aspen must come from all three states, in order to provide sufficient quantity for any of the mills except the 100-ton cold soda mill. It has been assumed that half of the indicated surplus allowable cut in Northern Wisconsin and Upper Michigan, would be available to a new producer. The remaining demand is assumed to come from Minnesota.

Dense hardwoods required for any of the proposed mills can be harvested wholly in Northern Wisconsin.

<u>Demand:</u> (100% Operation, 350 Days Per Year)	<u>Annual Cords</u>
a. <u>Newsprint, 500 TPD</u>	
1. Aspen Groundwood (Cord Volume 85 C.F., Density 23 P.C.F., Yield 95%)	122,400
2. Mixed Hardwood Cold Soda Pulp (Cord Volume 80 C.F., Density 34 P.C.F., Yield 85%)	24,600
3. Kraft Pulp (135 TPD to News, 165 TPD to Market)	
Softwood to News:	92,700
(Cord Volume 85 C.F., Density 24 P.C.F., Yield 50%)	
Hardwood to Market; 50% Aspen: (Yield 55%)	53,500
Hardwood to Market; 50% Mixed Dense: (Yield 50%)	42,500
b. <u>Hardwood Market Kraft, 300 TPD</u>	
1. 50% Aspen	97,300
2. 50% Mixed Dense Hardwoods	77,300
c. <u>Cold Soda Pulp, 100 TPD</u>	
1. 50% Aspen (75% Yield)	23,800
2. 50% Mixed Dense Hardwoods (75% Yield)	17,200

Supply: (Based on U.S. F.S. Data)

a. Total Surplus Allowable Cut in Cords on All Lands:

	<u>Aspen</u>	<u>Dense Hardwoods</u>	<u>Pine</u>	<u>Spruce and Fir</u>
Northern Wisconsin	68,000	108,000	-	-
Upper Peninsula Michigan	110,000	166,000	63,000	13,000
Superior & Central Districts, Minn.	476,000	181,000	53,000	138,000
Total	654,000	455,000	116,000	151,000

b. Pulpwood Costs:

	<u>Source</u>	<u>Price F.O.B. Cars</u>	<u>Delivery</u>	<u>Total</u>
Aspen	N. Wisconsin	13.50	3.50	17.00
Aspen	U.P. Michigan	14.50	6.00	20.50
Aspen	Minnesota	11.00	11.00	22.00
Hardwoods	N. Wisconsin	13.00	2.50	15.50
Pine	Minnesota	15.50	11.00	26.50
Spruce & Fir	Minnesota	21.00	11.00	32.00

c. Assumed Sources and Average Prices:

<u>Newsprint, W/O Kraft</u>	<u>Amount</u>	<u>Source</u>	<u>Cost</u>
Aspen	35,000	N. Wisconsin	17.00
Aspen	55,000	U.P. Michigan	20.50
Aspen	32,400	Minnesota	22.00
Aspen - Total	122,400	-	19.90
Mixed Hardwoods	24,600	N. Wisconsin	15.50

Newsprint, With Kraft

Aspen	35,000	N. Wisconsin	17.00
Aspen	55,000	U.P. Michigan	20.50
Aspen	85,900	Minnesota	22.00
Aspen - Total	175,900	-	20.54
Mixed Hardwoods	67,100	N. Wisconsin	15.50
Pine, Spruce, Fir	92,700	Minnesota	29.10 Avg.

Kraft Market Pulp Mill

Aspen	35,000	N. Wisconsin	17.00
Aspen	62,300	U.P. Michigan	20.50
Aspen - Total	97,300	-	19.24
Mixed Hardwoods	77,300	N. Wisconsin	15.50

Cold Soda Pulp Mill

Aspen	23,800	N. Wisconsin	17.00
Mixed Hardwoods	17,200	N. Wisconsin	15.50

IV - CAPITAL COSTS

CAPITAL COST ESTIMATE

1. NEWSPRINT MILL (PURCHASE KRAFT):

a. Purchased Kraft Pulping & Storage (135 TPD)	\$ 300,000
b. Cold Soda Plant: (100 TPD)	4,000,000
c. Groundwood Plant: (350 TPD)	3,500,000
d. Screen Room	2,000,000
e. Paper Room (Includes also stock preparation, finishing, shipping)	20,000,000
f. Woodyard and Wood Room	2,050,000
g. Electrical Distribution	2,400,000
h. Miscellaneous Facilities (fresh water, shop, offices, lockers, track, roads, sewers, fire protection, etc.)	2,800,000
i. Steam Power Plant	<u>12,500,000</u>

Project Direct Cost \$ 49,550,000

Project Overhead Cost 4,500,000

Contingency 2,500,000

Total Construction Cost \$ 56,550,000

Other Costs

Interest During Construction	\$ 2,500,000
Investigation & Organization	750,000
Financing	500,000
Start-Up	1,500,000
Initial Working Capital	<u>5,000,000</u>

Total 10,250,000

Total Project Cost \$ 66,800,000

Proposed Financing

6% Sinking Fund, Convertible Debentures \$ 34,000,000

Equity Capital 32,800,000

Total \$ 66,800,000

CAPITAL COST ESTIMATE (Continued)

2. NEWSPRINT MILL (MANUFACTURE KRAFT):

a. Cold Soda Plant (100 TPD)	\$ 4,000,000
b. Groundwood Plant (350 TPD)	3,500,000
c. Screen Room	2,000,000
d. Paper Room (includes also stock preparation, finishing, shipping)	20,000,000
e. Woodyard and Wood Room	3,590,000
f. Electrical Distribution (kraft plant elsewhere)	2,400,000
g. Miscellaneous Facilities (fresh water, shop, offices, lockers, track, roads, sewers, fire protection, etc.)	3,000,000
h. Steam Power Plant	15,950,000
i. Kraft Mill (300 TPD) (no drying)	10,500,000
j. Kraft Drying (165 TPD)	<u>2,550,000</u>

Project Direct Cost	\$ 67,490,000
Project Overhead Cost	5,760,000
Contingency	<u>3,400,000</u>
Total Construction Cost	\$ 76,650,000

Other Costs

Interest During Construction	\$ 3,400,000
Investigation & Organization	750,000
Financing	500,000
Start-Up	1,500,000
Initial Working Capital	<u>5,000,000</u>

Total	<u>11,150,000</u>
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Total Project Cost	\$ 87,800,000
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Attributable to Market Kraft Production:

Depreciable	\$ 14,000,000
Nondepreciable	<u>1,000,000</u>
Total	\$ 15,000,000

Proposed Financing

6% Sinking Fund, Convertible Debentures	\$ 44,000,000
Equity Capital	<u>43,800,000</u>
Total	\$ 87,800,000

CAPITAL COST ESTIMATE (Continued)

3. HARDWOOD KRAFT MARKET PULP MILL:

a. Wood Handling Equipment	\$ 2,548,000
b. Digester Room Equipment	1,200,000
c. Wash and Screen Room Equipment	1,680,000
d. Bleach Plant Equipment	2,980,000
e. Pulp Machine Room Equipment	4,200,000
f. Causticizing Equipment	1,390,000
g. Steam Power Plant Equipment	4,855,000
h. Miscellaneous Equipment	3,165,000
i. Building, Services, and Site	<u>6,729,000</u>

Project Direct Cost	\$ 28,747,000
Project Overhead Cost	2,100,000
Contingency	<u>1,500,000</u>
Total Construction Cost	\$ 32,347,000

Other Costs

Interest During Construction	\$ 1,400,000
Investigation & Organization	500,000
Financing	500,000
Start-Up	500,000
Initial Working Capital	<u>2,500,000</u>

Total	<u>5,400,000</u>
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Total Project Cost	\$ 37,747,000
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Proposed Financing

6% Sinking Fund, Convertible Debentures	\$ 19,000,000
Equity Capital	<u>18,747,000</u>
Total	\$ 37,747,000

CAPITAL COST ESTIMATE (Continued)

4. COLD SODA HARDWOOD PULP MILL

a. Wood Handling	\$ 700,000
b. Digester Room Equipment (including refiners)	1,930,000
c. Screening Facilities	500,000
d. Bleach Plant	750,000
e. Building and Services	<u>620,000</u>

Project Direct Cost \$ 4,500,000

Project Overhead Cost 450,000

Contingency 250,000

Total Construction Cost \$ 5,200,000

Other Costs

Interest During Construction \$ 125,000

Investigation & Organization 50,000

Financing 100,000

Start-Up 75,000

Initial Working Capital 200,000

Total 550,000

Total Project Cost \$ 5,750,000

Proposed Financing

6% Sinking Fund, Convertible Debentures \$ 5,750,000

V - OPERATING COSTS AND INCOME

For the newsprint operation, at both 75% and 100% operating levels, component cost sheets follow, covering respectively, groundwood pulp, cold soda pulp, kraft pulp, steam and power expense, and paper mill operating expense. It should be noted that the component pulp cost sheets do not include significant items of fixed and variable expense, such as steam and power, depreciation, and general overhead charges.

Since the newsprint operation purchasing its kraft pulp does not break even, a skeleton income statement is shown. Five-year statements of estimated income, projected cash flow, and projected balances are drawn for the newsprint plant with integrated kraft pulp mill, for the independent kraft pulp mill, and for the 100-ton cold soda pulp mill, integrated with an assumed existing paper mill.

Depreciation is computed on the basis of a 20-year average useful life of each plant. However, for purposes of computing Federal income taxes, depreciation is taken according to the "double declining balance" basis.

Capitalization, in the case of the three independent operations, is proposed at approximately 50% of the total in 6% Sinking Fund Convertible Debentures, and 50% in equity capital. The debentures are retired over a 15-year term, with half the annual retirement amount provided in cash, half in capital stock conversion.

Capitalization of the cost of the 100-ton integrated cold soda pulp mill, is proposed through 6% debentures. However, due to the connection of this operation to an existing plant, no specific retirement is contemplated.

Methods of capitalization and depreciation are assumed for demonstration, and do not necessarily represent the optimum selection for each case.

NEWSPRINT COMPONENT COST SHEETS

A. ASPEN GOUNDWOOD

(Purchased Kraft Pulp) 2/

	<u>Cost/Ton Pulp</u>	
	<u>75% Operation</u>	<u>100% Operation</u>
1. Pulpwood	\$ 21.48	\$ 21.48
2. Labor	4.45	3.70
3. Repair Labor and Materials	2.70	2.25
4. Supplies and Misc. Oper. Expense	<u>1.10</u>	<u>1.00</u>
Total	\$ 29.73	\$ 28.43
Groundwood Cost, Per Ton of Newsprint <u>1/</u>	\$ 19.30	\$ 18.50

1/ Groundwood is a 60% component (approximately) of newsprint.

2/ Newsprint mill with integrated kraft mill uses more aspen, hence a higher average freight cost, and resultant higher pulp cost, as follows:

1. Pulpwood	\$ 22.17	\$ 22.17
2,3,4. As before	<u>8.25</u>	<u>6.95</u>
Total	\$ 30.42	\$ 29.12
Groundwood Cost, Per Ton of Newsprint	\$ 19.70	\$ 19.00

B. MIXED HARDWOOD COLD SODA PULP

	<u>Cost/Ton Pulp</u>	
	<u>75% Operation</u>	<u>100% Operation</u>
1. Pulpwood	\$ 13.40	\$ 13.40
2. Labor	3.00	2.50
3. Chemicals	7.65	7.65
4. Repair Labor and Material	5.40	4.50
5. Supplies and Misc. Oper. Expense	<u>1.10</u>	<u>1.00</u>
Total	\$ 30.55	\$ 29.05
Cold Soda Cost, Per Ton of Newsprint *	\$ 4.95	\$ 4.70

* Cold Soda is a 15% component (approximately) of newsprint.

**NEWSPRINT AND MARKET PULP
COMPONENT COST SHEET**

**C. HARDWOOD AND SOFTWOOD KRAFT PULP
(300 TPD)**

(All Hardwood Tonnage Based on 50% Aspen,
50% Mixed Dense Hardwoods)

	Cost Per Ton of Pulp <u>1/</u>					
	75% Operation			100% Operation		
	135 TPD Soft- wood	165 TPD Hard- wood	300 TPD Hard- wood	135 TPD Soft- wood	165 TPD Hard- wood	300 TPD Hard- wood
1. <u>Pulpwood</u>						
Softwood	\$ 57.00	-	-	\$ 57.00	-	-
Aspen	-	\$ 19.00	-	-	\$ 19.00	-
Aspen	-	-	\$ 17.85	-	-	\$ 17.85
Hardwood	-	11.40	11.40	-	11.40	11.40
Total Pulpwood	\$ 57.00	\$ 30.40	\$ 29.25	\$ 57.00	\$ 30.40	\$ 29.25
2. <u>Chemicals</u>						
Cooking	\$ 2.46	\$ 2.46	\$ 2.46	\$ 2.46	\$ 2.46	\$ 2.46
Bleaching	7.88	11.73	11.73	7.88	11.73	11.73
Total Chemicals	\$ 10.34	\$ 14.19	\$ 14.19	\$ 10.34	\$ 14.19	\$ 14.19
3. <u>Labor</u>	\$ 8.85	\$ 8.85	\$ 11.60	\$ 7.35	\$ 7.35	\$ 9.65
Salaried Payroll	(Elsewhere)		1.80	(Elsewhere)		1.50
4. Fuel (including power)	(Elsewhere)		\$ 6.57	(Elsewhere)		\$ 6.57
5. Repair Labor & Material	\$ 3.60	\$ 3.60	\$ 3.60	\$ 3.00	\$ 3.00	\$ 3.00
6. Supplies & Misc. Oper. Expense	\$ 1.10	\$ 1.10	\$ 2.20	\$ 1.00	\$ 1.00	\$ 2.00
Total Cost	\$ 80.89	\$ 58.14	\$ 69.21	\$ 78.69	\$ 55.94	\$ 66.16
Kraft Pulp Cost, Per Ton						
Newsprint <u>2/</u>	\$ 21.80	-	-	\$ 21.22	-	-

1/ 300-TPD plant in connection with newsprint mill produces 135-TPD softwood pulp for news furnish and 165-TPD hardwood pulp for market.

300-TPD independent plant produces all hardwood pulp for market.

2/ Kraft is a 25% component (approximately) of newsprint.

NEWSPRINT AND MARKET PULP
COMPONENT COST SHEET (Continued)

D. STEAM AND POWER

				Cost Per Ton of News or Market Pulp	
				<u>Buy Kraft</u>	<u>Make Kraft</u>
1. Steam & Power, Btu Cost	NEWS			\$ 12.75	\$ 13.40
	MARKET KRAFT			-	6.57
2. Labor	NEWS	100%		1.32	1.13
		75%		1.68	1.36
	MARKET KRAFT	100%		-	1.40
		75%		-	1.68
3. Repair Labor & Material (All Charged to NEWS)		100%		0.85	1.00
		75%		1.05	1.20
4. Supplies & Misc. Oper. Expense		100%		0.50	0.50
		75%		0.60	0.60
Totals	NEWS	100%		\$ 15.42	\$ 16.03
		75%		\$ 16.08	\$ 16.56
	MARKET KRAFT	100%		-	\$ 7.97
		75%		-	\$ 8.25

Percent figures indicate Level of Operation.

NEWSPRINT COMPONENT COST SHEET

E. PAPER ROOM AND MISCELLANEOUS
PLANT ITEMS

	Cost/Ton News	
	<u>75% Operation</u>	<u>100% Operation</u>
1. Labor (including paper, finishing, yard, stores, clerical, etc.)	\$ 6.80	\$ 5.50
2. Machine Clothing and Other Operat- ing Supplies	6.25	6.25
3. Repair Labor and Material	2.00	2.00
4. Miscellaneous Operating Expense	1.00	1.00
5. Plant Superintendence Cost	<u>2.87</u>	<u>2.13</u>
Total	\$ 18.92	\$ 16.88

PRO FORMA COST SHEET AND INCOME STATEMENT
(FIRST YEAR)

NEWSPRINT MILL (PURCHASED KRAFT):

	<u>75% Operation</u> <u>130,000 TPY</u>		<u>100% Operation</u> <u>175,000 TPY</u>	
	<u>Per Ton</u>	<u>Annual</u>	<u>Per Ton</u>	<u>Annual</u>
<u>MILL COSTS:</u>				
Aspen Groundwood	\$ 19.30	\$ 2,509,000	\$ 18.50	\$ 3,238,000
Mixed Hardwood Cold Soda Pulp	4.95	644,000	4.70	823,000
Long-Fiber Pulp, Based on \$ 135/Ton Purchase	36.40	4,732,000	36.40	6,370,000
Steam Costs, Incl. Power	16.08	2,090,000	15.42	2,698,000
Paper Machine and Misc. Costs	<u>18.92</u>	<u>2,460,000</u>	<u>16.88</u>	<u>2,954,000</u>
Subtotal	\$ 95.65	\$ 12,435,000	\$ 91.90	\$ 16,083,000
<u>FIXED COSTS:</u>				
Freight Absorbed	\$ 10.00	\$ 1,300,000	\$ 10.00	\$ 1,750,000
General Admin. and Sales	6.70	871,000	5.00	875,000
Ad Valorem Tax (0.6%) <u>1/</u>	2.65	344,000	1.97	344,000
Insurance (0.3%) <u>1/</u>	1.32	172,000	0.98	172,000
Depreciation (5%) <u>1/</u>	22.04	2,865,000	16.37	2,865,000
Interest on Debt (6%) <u>2/</u>	<u>15.70</u>	<u>2,040,000</u>	<u>11.66</u>	<u>2,040,000</u>
Subtotal	\$ 58.41	\$ 7,592,000	\$ 45.98	\$ 8,046,000
Total Cost	\$ 154.06	\$ 20,027,000	\$ 137.88	\$ 24,129,000
Selling Price	\$ 135.00	\$ 17,550,000	\$ 135.00	\$ 23,625,000

COSTS ARE NOT MET BY SALES IN THIS OPERATION

1/ Based on \$ 57,300,000.

2/ Proposed Financing: 6% Convertible Debentures - \$ 34,000,000
Equity Capital - \$ 32,800,000

PRO FORMA COST SHEET

NEWSPRINT MILL (MANUFACTURE KRAFT):

	75% Operation				100% Operation				Combined	
	130,000 TPY News		43,500 TPY		175,000 TPY News		58,000 TPY		Operation	
	Per Ton	Annual	Per Ton	Market Pulp	Per Ton	Annual	Per Ton	Market Pulp	75%	100%
	\$	\$1,000	\$	\$	\$	\$1,000	\$	\$	\$1,000	\$1,000
MILL COSTS:										
Aspen Groundwood	19.70	2,561	-	-	19.00	3,326	-	-	2,561	3,326
Mixed Hardwood Cold Soda Pulp	4.95	644	-	-	4.70	823	-	-	644	823
Long-Fiber Kraft Pulp	21.80	2,834	-	-	21.22	3,714	-	-	2,834	3,714
Short-Fiber Kraft Pulp	-	-	58.14	2,529	-	-	55.94	3,245	2,529	3,245
Steam and Power Cost, Total	16.56	2,153	8.25	359	16.03	2,805	7.97	462	2,512	3,267
Paper Machine and Miscellaneous	18.92	2,460	-	-	16.88	2,954	-	-	2,460	2,954
Absorbed Freight	10.00	1,300	5.00	218	10.00	1,750	5.00	290	1,518	2,040
General Admin. and Sales	6.00	780	2.00	87	4.50	788	1.50	87	867	874
Ad Valorem Tax (0.6%) *	2.92	380	1.93	84	2.17	380	1.45	84	464	464
Insurance (0.3%) *	1.46	190	0.97	42	1.09	190	0.72	42	232	232
Depreciation (5%) *	24.38	3,170	16.09	700	18.11	3,170	12.07	700	3,870	3,870
Total Costs	126.69	16,472	92.38	4,019	113.70	19,900	84.65	4,910	20,491	24,809
Sales Revenues	135.00	17,550	152.00	6,612	135.00	23,625	152.00	8,816	24,162	32,441

* Based on \$77,400,000 Total; \$63,400,000 Newsprint; \$14,000,000 Market Kraft.

PROJECTED BALANCE SHEET
NEWSPRINT MILL (MANUFACTURE KRAFT)
100% CAPACITY OPERATION

	Begin Year (\$1,000)	End of Year (\$ 1,000)				
	<u>1</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
<u>ASSETS</u>						
Current Assets:						
Cash	-	7,395	14,966	22,416	29,008	34,829
Other	<u>5,000</u>	<u>5,000</u>	<u>5,000</u>	<u>5,000</u>	<u>5,000</u>	<u>5,000</u>
	5,000	12,395	19,966	27,416	34,008	39,829
Plant and Property	80,800	80,800	80,800	80,800	80,800	80,800
Depreciation Reserve	<u>-</u>	<u>3,870</u>	<u>7,740</u>	<u>11,610</u>	<u>15,480</u>	<u>19,350</u>
	80,800	76,930	73,060	69,190	65,320	61,450
Deferred Accounts:						
Financing Expense	500	436	376	320	268	222
Start-Up Expense	<u>1,500</u>	<u>1,000</u>	<u>500</u>	<u>-</u>	<u>-</u>	<u>-</u>
	<u>2,000</u>	<u>1,436</u>	<u>876</u>	<u>320</u>	<u>268</u>	<u>222</u>
Total	87,800	90,761	93,902	96,926	99,596	101,501

LIABILITIES

Taxes Accrued Over Paid	-	-	-	296	1,034	1,244
Long-Term Debt	44,000	41,067	38,134	35,201	32,268	29,335
Capital:						
Stock	43,800	45,266	46,732	48,198	49,664	51,130
Retained Earnings	<u>-</u>	<u>4,428</u>	<u>9,036</u>	<u>13,231</u>	<u>16,630</u>	<u>19,792</u>
	<u>43,800</u>	<u>49,694</u>	<u>55,768</u>	<u>61,429</u>	<u>66,294</u>	<u>70,922</u>
Total	87,800	90,761	93,902	96,926	99,596	101,501

FINANCIAL STATISTICS
(FIVE-YEAR AVERAGE)

	<u>(\$ 1,000)</u>
Net Worth	\$ 57,361
Total Investment	\$ 94,029
Net Profit	\$ 3,958
Profit - % Net Worth	6.9%
Profit - % Total Investment	4.2%

STATEMENT OF ESTIMATED INCOME AND CASH FLOW
 NEWSPRINT MILL (MANUFACTURE KRAFT)
 100% CAPACITY OPERATION

	End of Year (\$ 1,000)				
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
Sales	32,441	32,441	32,441	32,441	32,441
Cost of Operations	<u>24,809</u>	<u>24,809</u>	<u>24,809</u>	<u>24,809</u>	<u>24,809</u>
Gross Earnings	7,632	7,632	7,632	7,632	7,632
Interest	2,640	2,464	2,288	2,112	1,936
Amortization Financing Cost	64	60	56	52	46
Amortization Start-Up Cost	<u>500</u>	<u>500</u>	<u>500</u>	-	-
Total Deductions	3,204	3,024	2,844	2,164	1,982
Profit Before Federal Tax	4,428	4,608	4,788	5,468	5,650
Federal Income Tax <u>1/</u>	- <u>2/</u>	- <u>2/</u>	593 <u>2/</u>	2,069	2,488
Net Profit	4,428	4,608	4,195	3,399	3,162

Depreciation	3,870	3,870	3,870	3,870	3,870
Amortization Financing Cost	64	60	56	52	46
Amortization Start-Up Cost	500	500	500	-	-
Excess Tax Accrued Overpaid	<u>-</u>	<u>-</u>	<u>296</u>	<u>738</u>	<u>210</u>
Total Additions	4,434	4,430	4,722	4,660	4,126
Cash Flow	8,862	9,038	8,917	8,059	7,288
Less: Debentures Retired <u>3/</u>	1,467	1,467	1,467	1,467	1,467
Balance	7,395	7,571	7,450	6,592	5,821
Balance, Start Period	-	7,395	14,966	22,416	29,008
Balance, End Period	7,395	14,966	22,416	29,008	34,829

1/ Depreciation on double declining balance basis; 20-year life; allowance included for state income tax.

2/ Loss carry-over.

3/ Assumes 15-year retirement; half through cash, half converted to capital stock.

PRO FORMA COST SHEET

BLEACHED HARDWOOD MARKET KRAFT MILL, 300 TPD:

	<u>75% Operation</u>		<u>100% Operation</u>	
	<u>79,000 TPY</u>		<u>105,000 TPY</u>	
	<u>Per Ton</u>	<u>Annual</u>	<u>Per Ton</u>	<u>Annual</u>
	\$	\$ 1,000	\$	\$ 1,000
<u>Mill Costs</u>				
Pulpwood	29.25	2,311	29.25	3,071
Chemicals	14.19	1,121	14.19	1,490
Labor	13.40	1,059	11.15	1,171
Steam and Power	6.57	519	6.57	690
Repairs, Supplies, Misc.	5.80	458	5.00	525
Freight Absorbed	5.00	395	5.00	525
General Admin. and Sales	4.00	316	3.00	316
Ad Valorem Tax (0.6%) *	2.49	197	1.88	197
Insurance (0.3%) *	1.25	99	0.94	99
Depreciation (5%) *	<u>20.78</u>	<u>1,642</u>	<u>15.64</u>	<u>1,642</u>
Total Costs	102.73	8,117	92.62	9,726
Sales Revenues	152.00	12,008	152.00	15,960

* Based on \$ 32,847,000.

PROJECTED BALANCE SHEET
MARKET KRAFT MILL
100% CAPACITY OPERATION

	Begin Year (\$ 1,000)	End of Year (\$ 1,000)				
	<u>1</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
<u>ASSETS</u>						
Current Assets:						
Cash	-	5,630	10,330	14,410	18,308	22,095
Other	<u>2,500</u>	<u>2,500</u>	<u>2,500</u>	<u>2,500</u>	<u>2,500</u>	<u>2,500</u>
	2,500	8,130	12,830	16,910	20,808	24,595
Plant and Property	34,247	34,247	34,247	34,247	34,247	34,247
Depreciation Reserve	<u>-</u>	<u>1,642</u>	<u>3,284</u>	<u>4,926</u>	<u>6,568</u>	<u>8,210</u>
	34,247	32,605	30,963	29,321	27,679	26,037
Deferred Accounts:						
Financing Cost	500	436	376	320	268	222
Start-Up Cost	<u>500</u>	<u>200</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>
	1,000	636	376	320	268	222
Total	37,747	41,371	44,169	46,551	48,755	50,854
<u>LIABILITIES</u>						
Taxes Accrued Over Paid	-	472	1,007	1,168	1,265	1,355
Long-Term Debt	<u>19,000</u>	<u>17,733</u>	<u>16,466</u>	<u>15,199</u>	<u>13,932</u>	<u>12,665</u>
Capital:						
Stock	18,747	19,381	20,015	20,649	21,283	21,917
Retained Earnings	<u>-</u>	<u>3,785</u>	<u>6,681</u>	<u>9,535</u>	<u>12,275</u>	<u>14,917</u>
	18,747	23,166	26,696	30,184	33,558	36,834
Total	37,747	41,371	44,169	46,551	48,755	50,854

FINANCIAL STATISTICS
(FIVE-YEAR AVERAGE)

	(\$ 1,000)
Net Worth	27,790
Total Investment	43,623
Net Profit	3,213
Profit - % Net Worth	11.6%
Profit - % Total Investment	7.3%

STATEMENT OF ESTIMATED INCOME AND CASH FLOW
MARKET KRAFT MILL
100% CAPACITY OPERATION

	(End of Year \$ 1,000)				
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
Sales	15,960	15,960	15,960	15,960	15,960
Cost of Operations	<u>9,726</u>	<u>9,726</u>	<u>9,726</u>	<u>9,726</u>	<u>9,726</u>
Gross Earnings	6,234	6,234	6,234	6,234	6,234
Interest	1,140	1,064	988	912	836
Amortization Financing Cost	64	60	56	52	46
Amortization Start-Up Cost	<u>300</u>	<u>200</u>	<u>-</u>	<u>-</u>	<u>-</u>
Total Deductions	1,504	1,324	1,044	964	882
Profit Before Federal Tax	4,730	4,910	5,190	5,270	5,352
Federal Income Tax <u>1/</u>	945 <u>2/</u>	2,014	2,336	2,530	2,710
Net Profit	3,785	2,896	2,854	2,740	2,642

Depreciation	1,642	1,642	1,642	1,642	1,642
Amortization Financing Cost	64	60	56	52	46
Amortization Start-Up Cost	300	200	-	-	-
Tax Accrual (Excess Overpaid)	<u>472</u>	<u>535</u>	<u>161</u>	<u>97</u>	<u>90</u>
Total Additions	2,478	2,437	1,859	1,791	1,778
Cash Flow	6,263	5,333	4,713	4,531	4,420
Less: Debentures Retired <u>3/</u>	633	633	633	633	633
Balance	5,630	4,700	4,080	3,898	3,787
Balance, Start Period	-	5,630	10,330	14,410	18,308
Balance, End Period	5,630	10,330	14,410	18,308	22,095

1/ Depreciation on Double Declining Balance Basis;
20-Year Life; Allowance Included for State Income
Tax.

2/ Loss Carry-Over.

3/ Assumes 15-Year Retirement; Half Through Cash,
Half Converted to Capital Stock.

PRO FORMA COST SHEET AND ANALYSIS OF SAVINGS POTENTIAL

BLEACHED HARDWOOD COLD SODA PULP MILL, 100 TPD, INTEGRATED WITH AN EXISTING PAPER MILL

	<u>75% Operation</u>		<u>100% Operation</u>	
	<u>26,000 TPY</u>		<u>35,000 TPY</u>	
	<u>Per Ton</u>	<u>Annual</u>	<u>Per Ton</u>	<u>Annual</u>
	<u>\$</u>	<u>\$ 1,000</u>	<u>\$</u>	<u>\$ 1,000</u>
Pulpwood	\$ 19.20	\$ 499	\$ 19.20	\$ 672
Labor	3.00	78	2.50	88
Chemicals: Cooking	7.65	199	7.65	268
Bleaching	10.00	260	10.00	350
Repairs, Supplies, Misc.	7.00	182	6.00	210
Steam and Power	8.00	208	8.00	280
Mill Burden, as Applicable	1.30	34	1.00	35
Ad Valorem Tax (0.5%) *	1.23	32	0.91	32
Insurance (0.3%) *	0.58	15	0.43	15
Depreciation (5%) *	<u>10.12</u>	<u>263</u>	<u>7.51</u>	<u>263</u>
Mill Cost	\$ 68.08	\$ 1,770	\$ 63.20	\$ 2,213
Cost of Alternative Pulp Supply	\$ 115.00	\$ 2,990	\$ 115.00	\$ 4,025
Potential Gross Savings	\$ 46.92	\$ 1,220	\$ 51.80	\$ 1,812

* Based on \$5,250,000

PROJECTED BALANCE SHEET
COLD SODA PLANT
100% CAPACITY OPERATION

	Begin Year (\$ 1,000)	End of Year (\$ 1,000)				
	<u>1</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
<u>ASSETS</u>						
Current Assets:						
Cash	-	1,497	2,627	3,672	4,693	5,691
Other	<u>200</u>	<u>200</u>	<u>200</u>	<u>200</u>	<u>200</u>	<u>200</u>
	200	1,697	2,827	3,872	4,893	5,891
Plant and Property	5,375	5,375	5,375	5,375	5,375	5,375
Depreciation Reserve	<u>-</u>	<u>263</u>	<u>526</u>	<u>789</u>	<u>1,052</u>	<u>1,315</u>
	5,375	5,112	4,849	4,586	4,323	4,060
Deferred Accounts:						
Financing Cost	100	93	86	79	72	65
Start-Up Cost	<u>75</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>
	<u>175</u>	<u>93</u>	<u>86</u>	<u>79</u>	<u>72</u>	<u>65</u>
Total	5,750	6,902	7,762	8,537	9,288	10,016
<u>LIABILITIES</u>						
Taxes Accrued Over Paid	-	297	368	381	393	404
Long-Term Debt	5,750	5,750	5,750	5,750	5,750	5,750
Retained Earnings	<u>-</u>	<u>855</u>	<u>1,644</u>	<u>2,406</u>	<u>3,145</u>	<u>3,862</u>
Total	5,750	6,902	7,762	8,537	9,288	10,016

FINANCIAL STATISTICS
(FIVE-YEAR AVERAGE)

	(\$ 1,000)
Total Investment	\$ 7,681
Net Profit	\$ 786
Profit - % Total Investment	10.2%

STATEMENT OF ESTIMATED INCOME AND CASH FLOW
COLD SODA PLANT
100% CAPACITY OPERATION

	End of Year (\$ 1,000)				
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
Gross Savings	1,877	1,877	1,877	1,877	1,877
Interest	345	345	345	345	345
Amortization Financing Cost	7	7	7	7	7
Amortization Start-Up Cost	<u>75</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>
Total Deductions	427	352	352	352	352
Profit Before Federal Tax	1,450	1,525	1,525	1,525	1,525
Federal Income Tax <u>1/</u>	595 <u>2/</u>	736	763	786	808
Net Profit	855	789	762	739	717
<hr/>					
Depreciation	263	263	263	263	263
Amortization Financing Cost	7	7	7	7	7
Amortization Start-Up Cost	75	-	-	-	-
Tax Accrued Over Paid	<u>297</u>	<u>71</u>	<u>13</u>	<u>12</u>	<u>11</u>
Total Additions	642	341	283	282	281
Cash Flow	1,497	1,130	1,045	1,021	998
Balance, Start Period	-	1,497	2,627	3,672	4,693
Balance, End Period	1,497	2,627	3,672	4,693	5,691

1/ Depreciation on double declining balance basis; 20-year life; allowance included for state income tax.

2/ Loss carry-over.

APPENDIX TABLES

1. Newsprint production, imports, exports, and consumption in the United States, 1920-1958
2. Newsprint mills in the United States and Canada, December 31, 1958
3. Annual newsprint capacity and production in the United States and Canada, 1920-1960
4. Prices of newsprint delivered in New York City and average rail freight between Three Rivers, Quebec, and New York City, 1914-1958
5. Estimated pulpwood production in the United States, by regions and by hardwoods and softwoods, selected years 1899-1958
6. Estimated allowable cut, actual cut, and growth of growing stock in the northern Lake States, by species and survey districts

APPENDIX

Table 1.--Newsprint production, imports, exports, and consumption in the United States, 1920-1958

Year	U.S. production	Imports into the United States			U.S. exports	Consumption ²	Production as a % of consumption	Per capita consumption
		From Canada ¹	From Europe	Total				
	Thousand tons	Thousand tons	Thousand tons	Thousand tons	Thousand tons	Thousand tons	Percent	Pounds
1920.....	1,512	680	51	731	46	2,197	68.8	41.3
1921.....	1,225	657	135	792	17	2,000	61.2	36.9
1922.....	1,448	896	133	1,029	26	2,451	59.1	44.5
1923.....	1,485	1,108	200	1,308	16	2,777	53.5	49.6
1924.....	1,481	1,201	156	1,357	17	2,821	52.5	49.4
1925.....	1,530	1,315	133	1,448	23	2,955	51.8	51.0
1926.....	1,684	1,751	100	1,851	19	3,516	47.9	59.9
1927.....	1,486	1,865	122	1,987	12	3,461	42.9	58.2
1928.....	1,418	2,041	116	2,157	11	3,564	39.8	59.2
1929.....	1,409	2,327	96	2,423	19	3,787	37.2	62.2
1930.....	1,226	2,145	134	2,279	10	3,501	35.0	56.9
1931.....	1,203	1,916	151	2,067	10	3,297	36.5	53.2
1932.....	1,047	1,647	145	1,792	8	2,895	36.2	46.4
1933.....	928	1,640	153	1,793	11	2,654	35.0	42.3
1934.....	990	2,063	147	2,210	23	3,077	32.2	48.7
1935.....	948	2,186	197	2,383	22	3,347	28.3	51.1
1936.....	938	2,509	242	2,751	15	3,659	25.6	57.1
1937.....	976	3,023	294	3,317	17	3,867	25.2	60.0
1938.....	832	2,031	243	2,274	16	3,492	23.8	53.8
1939.....	954	2,302	310	2,612	13	3,543	26.9	54.1
1940.....	1,056	2,749	34	2,783	44	3,739	28.2	56.6
1941.....	1,044	2,979	3	2,982	70	3,922	26.6	58.8
1942.....	967	2,920	2	2,922	42	3,721	26.0	55.2
1943.....	811	2,637	--	2,637	35	3,559	22.8	52.1
1944.....	721	2,491	--	2,491	31	3,218	22.4	46.5
1945.....	725	2,669	--	2,669	44	3,451	21.0	49.3
1946.....	773	3,479	13	3,492	28	4,192	18.4	59.3
1947.....	833	3,828	129	3,957	29	4,658	17.9	64.6
1948.....	876	4,127	268	4,395	28	5,136	17.1	70.1
1949.....	918	4,382	257	4,639	39	5,532	16.6	74.2
1950.....	1,013	4,690	173	4,863	44	5,863	17.3	77.3
1951.....	1,108	4,756	207	4,963	71	5,872	18.9	76.1
1952.....	1,109	4,850	183	5,033	105	5,915	18.7	75.4
1953.....	1,069	4,841	163	5,004	47	6,109	17.5	76.6
1954.....	1,202	4,864	128	4,992	140	6,103	19.7	75.2
1955.....	1,459	5,013	146	5,159	207	6,485	22.5	78.5
1956.....	1,620	5,258	311	5,569	152	6,807	23.8	80.9
1957.....	1,794	5,066	155	5,221	174	6,768	26.5	79.1
1958 ³	1,723	4,737	146	4,883	127	6,501	26.5	74.7

¹ Includes Newfoundland.² Includes changes in stocks beginning in 1929.³ Preliminary estimates.Sources: Production, imports, exports and consumption, years 1920-1928, also imports 1929-1947, Newsprint Service Bureau, Bulletin No. 469, February 1957.Production, exports and consumption, 1929-1947, Business and Defense Services Administration, U.S. Department of Commerce, Pulp, Paper, and Board Supply-Demand, Report of the Committee on Interstate and Foreign Commerce, 85th Congress, 1st Session, House Report No. 573, June 1957.Imports and exports 1948-1957 and production and consumption 1948-1954, Business and Defense Services Administration, U.S. Department of Commerce, Pulp, Paper and Board, March 1958.Production and consumption, 1955-1958, Bureau of the Census, U.S. Department of Commerce, Facts for Industry.

Table 2.--Newsprint mills in the United States and Canada, December 31, 1958¹

Mill No.	Name of company	Location	Newsprint capacity ² (Short tons)	Percent of North America	Percent of United States
UNITED STATES					
North:					
1	Great Northern Paper Co.....	Millinocket, Maine.....	574,000	5.8	24.2
2	St. Croix Paper Co.....	Woodland, Maine.....	130,000	1.3	5.5
	Total North.....		704,000	7.1	29.7
South:					
3	Bowaters Southern Paper Corp.....	Calhoun, Tennessee.....	410,000	4.2	17.3
4	Coosa River Newsprint Co.....	Coosa Pines, Alabama.....	325,000	3.3	13.7
5	International Paper Co.....	Mobile, Alabama.....	115,000	1.2	4.9
6	International Paper Co.....	Pine Bluff, Arkansas.....	130,000	1.3	5.5
7	Southland Paper Mills, Inc.....	Lufkin, Texas.....	230,000	2.3	9.7
	Total South.....		1,210,000	12.3	51.1
West:					
8	Crown Zellerbach Corp.....	West Linn, Oregon.....	76,330	0.8	3.2
9	Crown Zellerbach Corp.....	Port Angeles, Washington.....	175,610	1.8	7.4
10	Inland Empire Paper Co.....	Millwood, Washington.....	22,170	0.2	0.9
11	Publishers Paper Co.....	Oregon City, Oregon.....	115,000	1.2	4.9
12	West Tacoma Newsprint Co.....	Steilacoom, Washington.....	65,000	0.6	2.8
	Total West.....		454,110	4.6	19.2
	Total United States.....		2,368,110	24.0	100.0
CANADA					
					Percent of Canada
Eastern:					
13	Anglo-Canadian Pulp & Paper Mills.....	Quebec, Quebec.....	265,000	2.7	3.5
14	Anglo-Newfoundland Development Co.....	Grand Falls, Newfoundland.....	250,000	2.5	3.3
15	Bowater's Newfoundland Pulp & Paper Mills.....	Corner Brook, Newfoundland.....	320,000	3.2	4.3
16	Canada Paper Co.....	Windsor Mills, Quebec.....	21,800	0.2	0.3
17	Canadian International Paper Co.....	Three Rivers, Quebec.....	334,800	3.4	4.5
18	Canadian International Paper Co.....	Gatineau, Quebec.....	307,380	3.1	4.1
19	Consolidated Paper Corp.....	Shawinigan Falls, Quebec.....	261,180	2.7	3.5
20	Consolidated Paper Corp.....	Grand Mere, Quebec.....	158,000	1.6	2.1
21	Consolidated Paper Corp.....	Port Alfred, Quebec.....	243,010	2.5	3.2
22	Consolidated Paper Corp.....	Three Rivers, Quebec.....	188,800	1.9	2.5
23	Donnacona Paper Co.....	Donnacona, Quebec.....	118,200	1.2	1.6
24	Donohue Brothers.....	Clermont, Quebec.....	120,000	1.2	1.6
25	E. B. Eddy Co., The.....	Hull, Quebec.....	57,000	0.6	0.8
26	James MacLaren Co.....	Buckingham, Quebec.....	127,000	1.3	1.7
27	Mersey Paper Co.....	Liverpool, Nova Scotia.....	145,500	1.5	1.9
28	New Brunswick International Paper Co.....	Dalhousie, New Brunswick.....	268,270	2.7	3.6
29	Price Brothers & Co.....	Kenogami, Quebec.....	485,000	4.9	6.5
30	Price Brothers & Co.....	Riverbend, Quebec.....			
31	Quebec North Shore Paper Co.....	Baie Comeau, Quebec.....	174,400	1.8	2.3
32	Richmond Pulp and Paper Co.....	Bromptonville, Quebec.....	115,875	1.2	1.6
33	St. Anne Paper Co.....	Beaupre, Quebec.....	127,850	1.3	1.7
34	St. Lawrence Corp.....	Dolbeau, Quebec.....	122,000	1.2	1.6
35	St. Lawrence Corp.....	Three Rivers, Quebec.....	224,840	2.3	3.0
36	St. Raymond Paper Co.....	St. Raymond, Quebec.....	26,200	0.3	0.4
	Total Eastern.....		4,462,105	45.3	59.6
Central:					
37	Abitibi Power & Paper Co.....	Fort William, Ontario.....	165,000	1.7	2.2
38	Abitibi Power & Paper Co.....	Iroquois Falls, Ontario.....	264,880	2.7	3.5
39	Abitibi Power & Paper Co.....	Port Arthur, Ontario.....	133,070	1.3	1.8
40	Abitibi Power & Paper Co.....	Sault Ste. Marie, Ontario.....	101,020	1.0	1.3
41	Beaver Wood Fiber Co.....	Thorold, Ontario.....	34,800	0.3	0.5
42	Great Lakes Paper Co.....	Fort William, Ontario.....	420,000	4.3	5.6
43	Manitoba Paper Co.....	Pine Falls, Manitoba.....	144,140	1.5	1.9
44	Ontario-Minnesota Pulp & Paper Co.....	Fort Frances, Ontario.....	64,500	0.6	0.9
45	Ontario-Minnesota Pulp & Paper Co.....	Kenora, Ontario.....	215,000	2.2	2.9
46	Ontario Paper Co.....	Thorold, Ontario.....	202,500	2.1	2.7
47	St. Lawrence Corp.....	Red Rock, Ontario.....	60,000	0.6	0.8
48	Spruce Falls Power & Paper Co.....	Kapuskasing, Ontario.....	254,000	2.6	3.4
	Total Central.....		2,058,910	20.9	27.5
West Coast:					
49	Crown Zellerbach Canada.....	Ocean Falls, British Columbia.....	95,000	1.0	1.2
50	Elk Falls Co.....	Campbell River, British Columbia.....	170,000	1.7	2.3
51	MacMillan & Bloedel.....	Port Alberni, British Columbia.....	200,000	2.0	2.7
52	Powell River Co.....	Powell River, British Columbia.....	500,000	5.1	6.7
	Total West Coast.....		965,000	9.8	12.9
	Total Canada.....		7,486,015	76.0	100.0
	Total United States and Canada.....		9,854,125	100.0	

¹ This list does not include producers who may occasionally produce small quantities of newsprint.² Annual capacity.Source: Estimates of capacity based on data published by the American Newspaper Publishers Association in Newsprint Bulletin No. 5, January 22, 1958; Newsprint Association of Canada in Newsprint Data, 1957, November 1957; Lockwood's Directory of the Paper and Allied Trades, 1958; and other sources.

Table 3.--Annual newsprint capacity and production in the United States and Canada, 1920-1960

Year	Total			United States			Canada		
	Capacity ¹	Production	Ratio of production to capacity	Capacity ¹	Production	Ratio of production to capacity	Capacity ¹	Production	Ratio of production to capacity
	Thousand tons	Thousand tons	Percent	Thousand tons	Thousand tons	Percent	Thousand tons	Thousand tons	Percent
1920.....	2,564	2,450	95.6	1,548	1,512	97.7	1,016	938	92.3
1921.....	2,819	2,077	73.7	1,668	1,225	73.4	1,151	852	74.0
1922.....	2,916	2,591	88.9	1,639	1,448	88.3	1,277	1,143	89.5
1923.....	3,043	2,815	92.5	1,578	1,485	94.1	1,465	1,330	90.8
1924.....	3,270	2,899	88.7	1,632	1,481	90.7	1,638	1,418	86.6
1925.....	3,544	3,149	88.9	1,721	1,530	88.9	1,823	1,619	88.8
1926.....	3,884	3,752	96.6	1,763	1,684	95.5	2,121	2,068	97.5
1927.....	4,504	3,776	83.8	1,788	1,486	83.1	2,716	2,290	84.3
1928.....	4,997	4,030	80.6	1,735	1,418	81.7	3,262	2,612	80.1
1929.....	5,253	4,393	83.6	1,741	1,409	80.9	3,512	2,984	85.0
1930.....	5,589	4,017	71.9	1,687	1,226	72.7	3,902	2,791	71.5
1931.....	5,895	3,719	63.1	1,768	1,203	68.0	4,127	2,516	61.0
1932.....	5,913	3,233	54.7	1,771	1,047	59.1	4,142	2,186	52.8
1933.....	5,884	3,210	54.6	1,735	928	53.5	4,149	2,282	55.0
1934.....	5,896	3,901	66.2	1,714	990	57.8	4,182	2,911	69.6
1935.....	5,767	4,031	69.9	1,504	948	63.0	4,263	3,083	72.3
1936.....	5,689	4,473	78.6	1,471	938	63.8	4,218	3,535	83.8
1937.....	5,675	4,974	87.6	1,464	976	66.7	4,211	3,998	94.9
1938.....	5,629	3,725	66.2	1,094	832	76.1	4,535	2,893	63.8
1939.....	5,605	4,129	73.7	972	954	98.1	4,633	3,175	68.5
1940.....	5,797	4,826	83.2	1,081	1,056	97.7	4,716	3,770	79.9
1941.....	5,788	4,815	83.2	1,085	1,044	96.2	4,703	3,771	80.2
1942.....	5,889	4,422	75.1	1,126	967	85.9	4,763	3,455	72.5
1943.....	5,711	4,030	70.6	1,033	811	78.5	4,678	3,219	68.8
1944.....	5,759	3,986	69.2	1,033	721	69.8	4,726	3,265	69.1
1945.....	5,653	4,317	76.4	981	725	73.9	4,672	3,592	76.9
1946.....	5,480	5,279	96.3	839	773	92.1	4,641	4,506	97.1
1947.....	5,574	5,653	101.4	845	833	98.6	4,729	4,820	101.9
1948.....	5,733	5,859	102.2	850	876	103.1	4,883	4,983	102.0
1949.....	5,989	6,094	101.8	876	918	104.8	5,113	5,176	101.2
1950.....	6,219	6,292	101.2	992	1,013	102.1	5,227	5,279	101.0
1951.....	6,410	6,624	103.3	1,050	1,108	105.5	5,360	5,516	102.9
1952.....	6,675	6,796	101.8	1,165	1,109	95.2	5,510	5,687	103.2
1953.....	6,893	6,790	98.5	1,170	1,069	91.4	5,723	5,721	100.0
1954.....	7,200	7,186	99.8	1,280	1,202	93.9	5,920	5,984	101.1
1955.....	7,473	7,650	102.4	1,409	1,459	103.5	6,064	6,191	102.1
1956.....	7,868	8,089	102.8	1,625	1,620	99.7	6,243	6,469	103.6
1957.....	8,677	8,191	94.4	1,921	1,794	93.4	6,756	6,397	94.7
1958.....	9,375	² 7,819	83.4	2,100	² 1,723	82.0	7,275	² 6,096	83.8
1959.....	9,950	--	--	2,400	--	--	³ 7,550	--	--
1960.....	10,075	--	--	2,475	--	--	³ 7,600	--	--

¹ Based on normal full operating programs.² Preliminary estimates.³ Capacity as of January 1, 1960.Sources: Capacity and production in Canada and capacity in the United States, 1920-1957, Newsprint Association of Canada, Annual Newsprint Supplement, April 1958.Production in the United States, 1920-1928, Newsprint Service Bureau, Bulletin No. 469, February 1957; 1929-1958, Bureau of the Census, U. S. Department of Commerce.Capacity in Canada and the United States, 1958-1960, Business and Defense Services Administration, U. S. Department of Commerce, Pulp, Paper, and Board Supply-Demand, Newsprint Outlook, Report of the Committee on Interstate and Foreign Commerce, 85th Congress, 2d Session, House Report No. 1868, 1958.Production in Canada in 1958, American Newspaper Publishers Association Newsprint Statistics, 1958, Newsprint Bulletin No. 11, February, 1959.

Table 4.--Prices of newsprint delivered in New York City and average rail freight between Three Rivers, Quebec, and New York City, 1914-1958

Year	Newsprint prices ¹		Average rail freight ²		Rail freight as a percent of newsprint price
	Actual dollars	1947-49 dollars	Actual dollars	1947-49 dollars	
	<u>Dollars per ton</u>	<u>Dollars per ton</u>	<u>Dollars per ton</u>	<u>Dollars per ton</u>	<u>Percent</u>
1914.....	43.60	98.40	3.60	8.15	8.3
1915.....	41.78	92.45	3.78	8.35	9.0
1916.....	51.78	93.15	3.78	6.80	7.3
1917.....	63.78	83.50	3.78	4.95	5.9
1918.....	64.30	75.40	4.30	5.05	6.7
1919.....	79.40	88.10	5.40	6.00	6.8
1920.....	112.60	112.25	7.60	7.60	6.7
1921.....	111.35	175.65	7.60	12.00	6.8
1922.....	76.80	122.30	6.80	10.85	8.9
1923.....	81.80	125.10	6.80	10.40	8.3
1924.....	80.80	126.65	6.80	10.65	8.4
1925.....	76.80	114.10	6.80	10.10	8.9
1926.....	71.80	110.45	6.80	10.45	9.5
1927.....	71.80	115.80	6.80	10.95	9.5
1928.....	67.50	107.30	6.80	10.80	10.1
1929.....	62.00	100.15	6.80	11.00	11.0
1930.....	62.00	110.50	6.80	12.10	11.0
1931.....	57.00	120.25	6.80	14.35	11.9
1932.....	50.38	119.65	7.20	17.10	14.3
1933.....	41.25	96.40	6.80	15.90	16.5
1934.....	40.00	82.15	6.80	13.95	17.0
1935.....	40.00	76.90	6.80	13.10	17.0
1936.....	41.00	78.10	6.80	12.95	16.6
1937.....	42.50	75.75	6.40	11.40	15.1
1938.....	50.00	97.85	6.85	13.40	13.7
1939.....	50.00	99.80	7.00	13.95	14.0
1940.....	50.00	97.85	7.00	13.70	14.0
1941.....	50.00	88.05	7.00	12.30	14.0
1942.....	50.00	77.90	7.32	11.40	14.6
1943.....	54.69	81.65	7.15	10.65	13.1
1944.....	58.00	85.80	7.00	10.35	12.1
1945.....	60.25	87.55	7.00	10.15	11.6
1946.....	72.29	91.85	7.40	9.40	10.2
1947.....	88.62	91.95	8.98	9.30	10.1
1948.....	97.69	93.55	11.40	10.90	11.7
1949.....	100.00	100.80	11.80	11.90	11.8
1950.....	100.92	97.90	12.60	12.20	12.5
1951.....	110.50	96.25	13.73	11.95	12.4
1952.....	120.25	107.75	14.40	12.90	12.0
1953.....	125.50	114.00	14.40	13.10	11.5
1954.....	125.75	114.00	14.40	13.05	11.5
1955.....	125.94	113.75	14.40	13.00	11.4
1956.....	130.10	113.80	15.20	13.30	11.7
1957.....	133.59	113.60	16.20	13.80	12.1
1958.....	134.40	112.75	17.00	14.25	12.6

¹ Prices 1951-1958, represent average delivered newsprint prices in the United States.

² 1952-1958 freight rates as of July 1.

Sources: Newsprint prices, 1914-1931, Kellogg, Royal S., Newsprint Paper in North America, 1948, 1932-1958, Bureau of Labor Statistics, U.S. Department of Labor, Wholesale Prices and Price Indexes.

Freight, 1914-1951, U.S. Department of Commerce, Transportation Factors in the Marketing of Newsprint, 1952-1958, Compiled by the Traffic Management Branch, Commodity Stabilization Service, U. S. Department of Agriculture from interstate rail freight rates filed with the Interstate Commerce Commission.

Table 5.--Estimated pulpwood production in the United States, by regions and by hardwoods and softwoods, selected years, 1899-1958¹

Year	All regions			North			South			West, total ²
	Total	Hardwoods	Softwoods	Total	Hardwoods	Softwoods	Total	Hardwoods	Softwoods	
	<u>Million cords</u>	<u>Million cords</u>	<u>Million cords</u>	<u>Million cords</u>	<u>Million cords</u>	<u>Million cords</u>	<u>Million cords</u>	<u>Million cords</u>	<u>Million cords</u>	<u>Million cords</u>
1899.....	1.6	0.5	1.2	1.4	0.5	1.0	--	--	--	0.2
1905.....	2.5	.4	2.1	2.5	.4	2.1	0.1	--	0.1	--
1910.....	3.1	.8	2.3	2.8	.7	2.1	.3	0.1	.1	.1
1916.....	4.4	.7	3.7	4.2	.6	3.6	.2	.2	.1	--
1920.....	5.0	.8	4.3	4.5	.5	4.0	.4	.3	.1	.2
1925.....	5.0	.7	4.3	4.1	.4	3.7	.6	.3	.3	.3
1930.....	6.1	.8	5.3	3.9	.4	3.5	1.0	.4	.5	1.2
1935.....	6.6	.9	5.7	2.9	.3	2.6	1.4	.6	.9	2.2
1941.....	14.2	1.8	12.3	4.4	1.1	3.3	7.2	.7	6.4	2.6
1942.....	14.9	1.9	13.0	5.0	1.2	3.8	7.3	.7	6.6	2.6
1943.....	13.6	1.8	11.8	4.0	1.1	2.9	7.1	.7	6.5	2.5
1944.....	15.3	2.0	13.4	4.6	1.0	3.5	8.2	1.0	7.2	2.6
1945.....	15.3	2.2	13.1	4.7	1.1	3.6	8.1	1.1	7.0	2.5
1946.....	17.0	2.6	14.4	5.6	1.4	4.2	8.8	1.2	7.6	2.6
1947.....	18.5	2.5	16.0	5.6	1.3	4.3	9.3	1.2	8.1	3.6
1948.....	20.0	2.5	17.5	5.4	1.2	4.2	11.4	1.3	10.1	3.3
1949.....	17.6	2.3	15.3	4.6	1.3	3.3	9.9	1.0	8.9	3.1
1950.....	20.7	2.9	17.8	5.0	1.7	3.3	12.4	1.2	11.2	3.3
1951.....	25.1	3.8	21.3	6.3	2.2	4.1	14.1	1.6	12.5	4.7
1952.....	25.1	3.7	21.4	6.0	1.9	4.1	14.6	1.8	12.8	4.5
1953.....	26.3	4.2	22.1	5.4	2.2	3.2	16.2	2.0	14.2	4.7
1954.....	27.0	4.8	22.2	5.5	2.6	2.9	16.4	2.2	14.2	5.1
1955.....	30.9	5.3	25.6	6.3	2.7	3.6	18.4	2.6	15.8	6.2
1956.....	35.2	6.1	29.1	7.3	3.2	4.1	20.3	2.9	17.4	7.6
1957.....	34.4	6.2	28.2	7.2	3.2	4.0	19.8	3.0	16.8	7.4
1958 ³	32.9	6.0	26.9	7.0	3.2	3.8	18.9	2.8	16.1	7.0

¹ Data may not add to totals because of rounding.

² Practically all softwoods.

³ Preliminary. Subject to revision.

Source: Bureau of the Census, U.S. Department of Commerce and Forest Service, U.S. Department of Agriculture.

Table 6.--Estimated allowable cut, actual cut, and growth of growing stock in the northern Lake States, by species and survey districts

(Thousand cords)

District ¹	Aspen	Other hardwoods ²	Spruce	Balsam fir	Red and jack pine	Other softwoods
Northern Wisconsin:						
Northeast:						
Allowable cut.....	357	145	14	24	50	119
Actual cut.....	339	95	15	30	34	112
Growth.....	418	259	38	66	47	86
Northwest:						
Allowable cut.....	380	146	7	22	42	57
Actual cut.....	288	73	5	15	49	70
Growth.....	526	387	30	58	83	78
Central:						
Allowable cut.....	87	67	--	1	32	22
Actual cut.....	128	83	1	2	85	25
Growth.....	168	94	2	3	59	30
Northern Michigan:						
Eastern Upper Peninsula:						
Allowable cut.....	211	143	75	85	62	222
Actual cut.....	113	19	42	56	7	92
Growth.....	270	273	96	185	140	240
Western Upper Peninsula:						
Allowable cut.....	187	79	45	57	10	190
Actual cut.....	175	38	66	84	2	210
Growth.....	396	424	78	123	56	143
Northern Lower Peninsula:						
Allowable cut.....	451	206	13	23	98	83
Actual cut.....	231	35	3	3	56	29
Growth.....	535	753	21	62	315	190
Northern Minnesota:						
Superior:						
Allowable cut.....	355	95	182	105	264	96
Actual cut.....	196	15	116	55	149	46
Growth.....	655	182	152	258	59	108
Central Pine:						
Allowable cut.....	535	138	51	82	144	74
Actual cut.....	218	36	49	63	205	40
Growth.....	825	281	91	175	200	156
Rainy River:						
Allowable cut.....	75	20	77	36	14	40
Actual cut.....	71	4	118	42	16	30
Growth.....	139	69	96	38	19	82

¹ For map of districts, see figure 7.

² Poletimber trees only; excludes approximately 40 percent of total volume of other hardwoods in sawtimber-size trees.

Source: Forest Service, U.S. Department of Agriculture.

